

WBE
096P
1890

PRACTICAL ELECTRICITY

OVERALL

NATIONAL LIBRARY OF MEDICINE



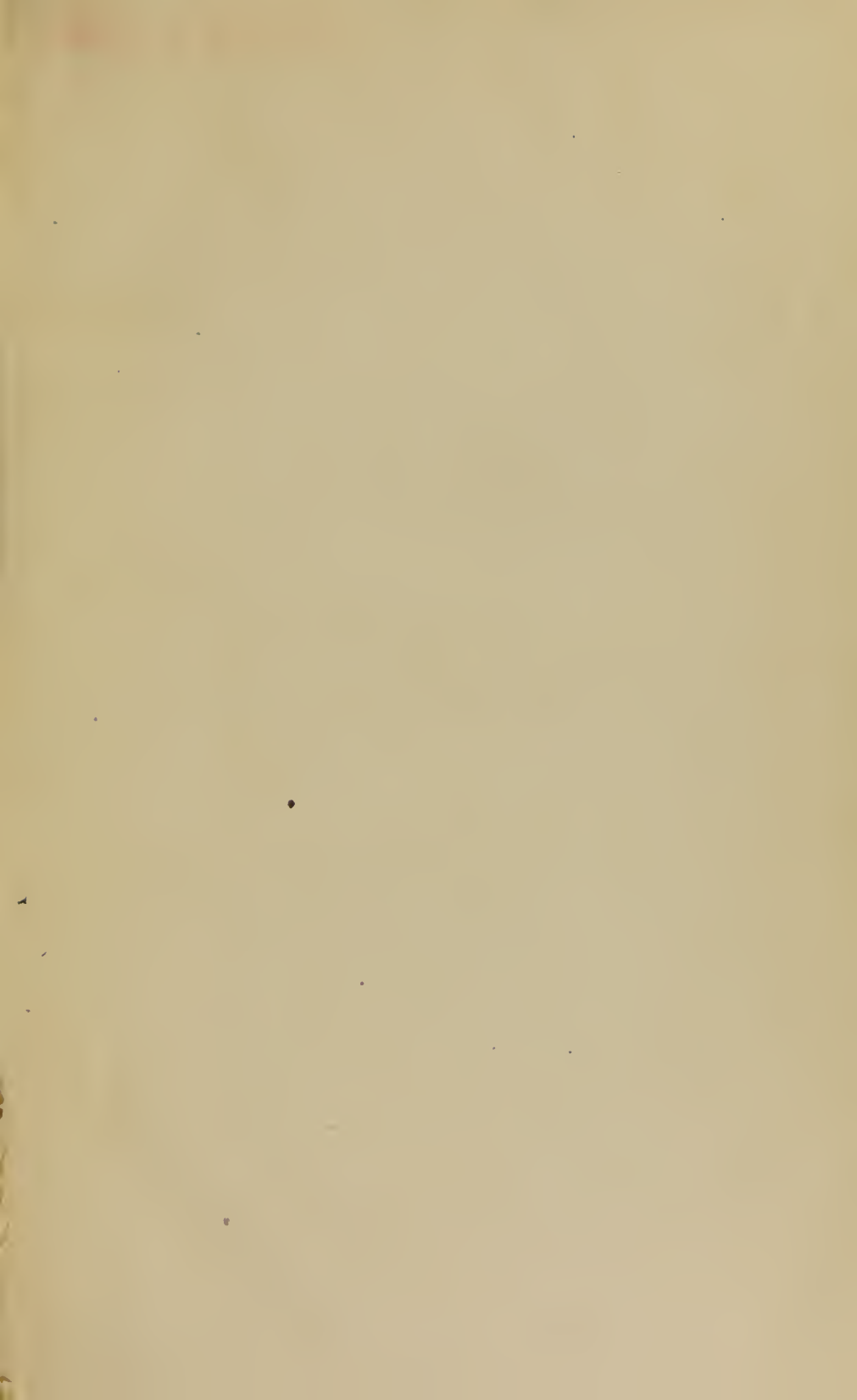
NLM 00103423 1

SURGEON GENERAL'S OFFICE

LIBRARY.

Section,

No. 129470.



100

PRACTICAL ELECTRICITY

IN

MEDICINE AND SURGERY



BY

G. W. OVERALL, M. D.

FORMERLY PROFESSOR OF PHYSIOLOGY, NERVOUS DISEASES AND ELECTRO-THERAPEUTICS
IN MEMPHIS HOSPITAL MEDICAL COLLEGE.

PRESS OF MEMPHIS PRINTING COMPANY

1890

Annex
WBE
096p
1890

FILM no 2847, no. 4

PREFACE.

THIS brief treatise owes its origin to the numerous letters of inquiry upon the subject that followed the publication of various articles by the author in *The Mississippi Valley Medical Journal*, *The Alienist and Neurologist*, and other Southern medical journals.

In presenting it to the profession the author has not essayed to proclaim new therapeutic measures, nor even to add new doctrines to already well-founded principles ; but rather, by avoiding compilation from other authors, to give a short and concise summary of the practical uses of electricity as confirmed by numerous years of experience, and to demonstrate its value in certain diseases (such as the cure of stricture by electrolysis), the treatment of which, by this method, has been hitherto regarded with indifference by some and over-rated by others.

If in doing this it will prove of any service to those interested in this method of treatment its mission will have been fully performed, and the author shall feel amply repaid for his labors.

Memphis, Tenn., January 1890.

CONTENTS.

INTRODUCTION.

PART I.

ELECTRO-PHYSICS—The Galvanic Cell. The Galvanic Battery. The Galvanic Current. The Faradic Current. The Secondary Faradic Current. The Static Current. Units of Measurement.

PART II.

ELECTRO-PHYSIOLOGY—Effect of the Galvanic Current. Effects of the Faradic Current. Effects of the Static Current. Electro-diagnosis.

PART III.

ELECTRO-THERAPY—Modes of Application. Special Electrodes. The Electric Cabinet Vapor Bath. The Electric Tub Bath. Treatment of Special Diseases Brain, Paralysis, Neuralgia, Rheumatism, Epilepsy, Chorea, Amenorrhoea.

PART IV.

ELECTRO-SURGERY—Electrolysis—In Organic Diseases of Women—In Stricture—Electro-Cautery--Batteries and Electrodes--Advantages and Uses.

CONCLUSION.

Care of Batteries. Battery Fluids.

INTRODUCTION.

Prior to entering upon the discussion of electro-therapeutics proper (or the medical uses of electricity), in order that the readers of this work may more fully understand its pages and obtain a clearer insight into the more complicated uses of electricity which must necessarily be employed in order to accomplish desired results, and also in order to show that the medical employment of electrical currents does not merely comprise a comparatively few years' experience of uncertain experimenting as to its usefulness in overcoming diseased conditions of the body, but that it has been used with advantage ever since its discovery, and only hitherto been disregarded on account of want of knowledge regarding its rightful application, I deem it proper to give a brief sketch of its history and such explanation of its scientific principles as may be necessary to elucidate subsequent discussions.

Electricity, far from being a modern discovery, dates its introduction to human knowledge away back to days of antiquity, when inhabitants along the Baltic Sea were wont to rub the pieces of amber (whence the name, *electros-amber*) found along its shores and produce the phenomena so familiar to us. Yet, beyond this slight knowledge of its existence, no practical discoveries of its usefulness were made until the eighteenth century, when Jallabert used it as a medical agent in the cure of paralysis. Shortly after this Franklin also used it for the same purpose and by him and other physicians of his time, who devoted the well-spent hours necessary to attain a knowledge justifying a profitable application, was it used with happy results in the treatment of many of the different nervous diseases. Still, it was not until after the discoveries of Galvani, Faraday, and Pixii had been added to the former discoveries that the field of electro-therapeutics became sufficiently extensive to justify successful treatment of all chronic troubles by the use of the electric current. However, since these important additions, in conjunction with still more recent developments, the wonderful curative powers of electricity have been so frequently and successfully demonstrated that, in the hands of one well versed in

its various phenomena and who fully understands its proper application, it proves one of the most efficient remedies a physician can employ; and, as a factor potent in its special class of diseases, it is second to none in usefulness.

The proper use of so intricate and yet so worthy a remedy could not be brought to perfection by a merely superficial series of experiments, nor can at present a passing glance at a standard author warrant sufficient knowledge for successful treatment by its use. The different currents and different strengths—each are studies in themselves that demand careful perusal on the part of the student, of each and every form separately, as though it were an independent study bearing only a distant relation to the common subject. This accounts for, in part, why the general practitioner of medicine too frequently wholly neglects the agent that will bring about the best results in the treatment of his patients suffering from nervous and chronic diseases, and resorts to the use of drugs that will frequently do infinitely more harm than no treatment at all. Not that this is a willful neglect on the part of a conscientious physician who always tries to do the best by his patients, but rather because, even though he would have sufficient time amid his numerous duties to study thoroughly the applications of the different currents, facilities for their use and necessary equipment in order to justify gratifying results would be wanting. In short, electrical treatment is a specialty that demands for the successful management of cases, a specialist who can devote the greater part of his time to the supervision of special apartments, and special equipments that cannot receive necessary attention in the busy routine of a general practice. In the hands of such an one sufficiently skilled to cope with the various forms of chronic diseases, and possessing all requisite appliances, the efficacies of electrical treatment cannot fail to prove itself as being far superior to all agents that may be employed for the relief of this form of diseases.

Like all other potent therapeutical agents, electricity has its friends who are over-enthusiastic in its curative powers and would claim beneficial results by its use in all manner and forms of disease, and also its enemies who deny its usefulness in any disease, firmly avowing negative results wherever it is used, and even go so far as to declare it a dangerous and harmful agent whose injuries upon the system always

exceed its benefits. Its enthusiastic advocates, on the one hand, cannot claim for it potency sufficient to make it antagonistic to all forms of maladies, be they great or small, acute or chronic. It is not a cure-all. Its field of usefulness lies not in its application to anticipate a febrile rise of temperature, nor is its surgical employment intended to supplant the knife—to make medicine and surgery alike subservient to its powers and throw equally valuable medicinal agents and surgical appliances into disuse. Electricity, like all other remedies, has its limit of utility and it is within these bounds that its marvelous benefits are wrought. As little as we might expect to cure dyspepsia by surgical procedure or remove a cancerous growth by the administration of tonics, so little also may we expect any happy results from the use of electricity beyond the scope of maladies within its domain.

Electricity yields negative results wherever its application is not thoroughly understood—as, when the galvanic current is used where the faradic should be used, or when too weak or too strong a current: either has no effect, or irritates the parts; or, when it is made to comprise the whole treatment, and no pains are taken to ascertain the underlying cause of the disease and that also judiciously treated, nor to build up the general system in conjunction with this treatment. As is the folly of treating a patient with tonics with a view of adding weight to his body and still denying him the proper food for the accomplishment of that purpose obviously evident, so also should be the treatment of a patient by electricity without attention to general hygienic principles.

The efficacies of electro-therapeutics are denied by those who, in good faith, have never devoted sufficient time to the study of its proper application and hence every trial has been attended by failure, and by those who, sceptically biased, have never directed their attention to its uses and in order to smother its growing popularity declare it harmful in effect and too dangerous for use. Because a remedy is not rightly understood and its use is not attended with success merely for want of knowledge on the part of those who deny proper time to its study, it does not necessitate abandonment on the part of others who are thoroughly versed in its effects and in whose hands it does not fail, and much less should it be undervalued because subtle charlatans with medical pretenses ensnare unwary victims by its improper uses.

In the hands of an incompetent physician all therapeutical agents are dangerous, be it an opiate or sage tea, massage or mustard, and electricity is no exception to the rule ; yet who would decry the beneficial effects of an opiate prescribed by an able physician. And since therefore most of our worthy remedies have a dangerous side if carelessly employed, why then should the use of the electrical current be abandoned when other agents, infinitely more dangerous, still maintain full sway in the treatment of disease ?

Electrical treatment is a method of treatment that has come to stay. Prejudice cannot uproot it, nor bungling usage soil successful records. Yearly as new and more efficient methods and apparati were brought into use, its range of employment grew larger and its triumphs of success became more apparent, and to-day, from among all the various remedies administered for the cure of nervous and chronic diseases, electricity indisputably ranks foremost among the therapeutical agents at command of the physician.

The subject may be embraced under four grand divisions, a thorough knowledge of each of which is essential to a correct and systematic application of the different electric currents. These divisions are : Electro-Physics, Electro Physiology, Electro-Therapy, and Electro-Surgery.

PART I.—ELECTRO-PHYSICS.

All substances, be they organic or inorganic, contain an imponderable and insensible fluid, known as *electrical potential*, that always exists either in a positive or negative state. Bodies sufficiently charged with this fluid, when brought into close proximity to one another, will, if they contain like forms—both positive or both negative, repel; if, however, they hold unlike forms—one positive and the other negative, they will attract one another. Hence, the laws of attraction and repulsion; that like repels, and unlike attracts. The molecules of all bodies have these forces so evenly counterbalanced, by virtue of the attractive and repulsive power of each individual molecule, as to hold the fluid in a state of perfect quietude, and it is only when this equilibrium is disturbed that the electric current is manifested.

If this equilibrium is disturbed by friction it is called static, Franklinic, or frictional electricity; when disturbed by chemical action it produces the dynamic current.

All substances do not contain the *electrical potential* in the same proportion; in fact, they differ very much as to their degree of potency; so that a higher *potential* element is always positive to a lower that is negative. Hence, a body may be positive to another of lower *potential* that is negative, yet negative to a third of higher *potential*, which is positive. For example: Zinc is positive when coupled with copper, but negative with sodium, while copper is positive to carbon negative.

If two elements, metallic or non-metallic, but differing in *electrical potential*, be connected at one extremity by a conductor and immersed into a fluid capable of chemical action upon the higher, an electric current is at once produced which passes from the higher or positive element to the lower or negative. Substances so arranged in a cup constitute a galvanic cell; as, figure 1.



Fig. 1.

The greater the difference in *electric potential* of elements composing a galvanic cell, all other things being equal, so much greater, in direct proportion, is the electro motor force arising therefrom : as, a cell constructed of zinc and carbon generates a stronger current than one constructed of zinc and copper.

THE GALVANIC CELL.

Fig. 1 represents a galvanic cell composed of zinc and carbon elements with dilute sulphuric acid as the exciting fluid and bichromate of potash to prevent polarization.

The positive electricity arises from the zinc plate ; passes through the fluid to the carbon, and out through the wire attached thereto as *positive pole*, although it is the negative element. The wire attached to the zinc (the positive element) is the *negative pole*. If these wires are brought together there is formed a closed circuit ; if, however, they are not connected, it constitutes an open circuit.

THE GALVANIC BATTERY.

When two or more cells are so arranged that the zinc of one is connected with the carbon of another, it forms a compound circuit or galvanic battery (Fig. 2).

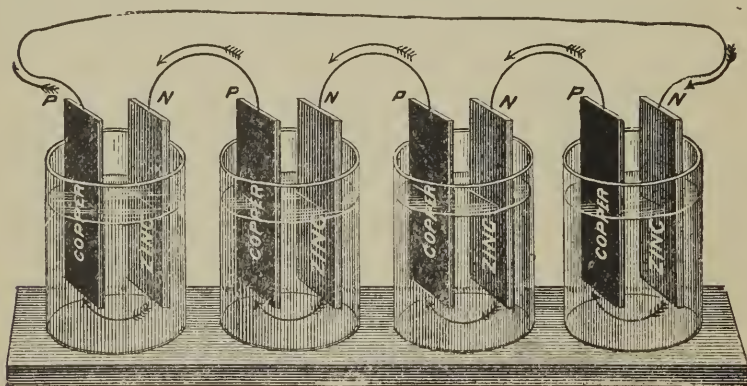


Fig. 2.

Galvanic cells are constructed both with regard to their cost and utility. Zinc is used almost exclusively as the positive element ; carbon, platinum, and copper as the negative. The cells in most general

use are the Bunson, Leclanche, and Gravity, with their various modifications by different manufacturers, each of which possesses superiority in the special use for which it may be intended.

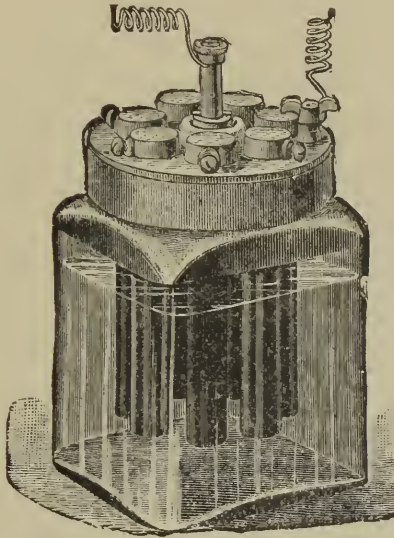


Fig. 3. The Open Circuit Cell.

The *open circuit cell* (fig. 3) is best suited for stationary office batteries, as there is but little or no action or determination of elements except when in use. The only disadvantage is that it cannot be used for any continuous length of time, since it requires rest to recuperate after half an hour's use. The Leclanche or modifications of it are the best.

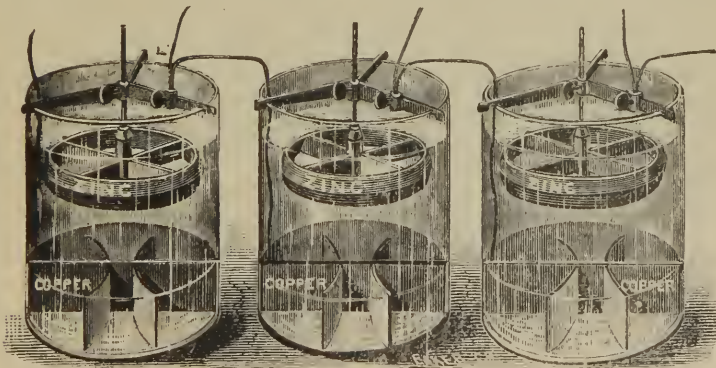


Fig. 4. Gravity Cells

For constant use the gravity cell (fig. 4), which is employed exclusively in telegraphy, is the best. It is a cell that must be used at least several hours daily to keep it in working order.

The Bunson (fig. 2), or its modifications, is best adapted for electrolysis.

THE GALVANIC CURRENT.

The current that flows through these various cells when in proper connection is known as the continuous or Galvanic current. It is a current that traverses the circuit uninterruptedly and with a uniformity and strength varying in proportion to the power and endurance of the cells.

In considering the construction of a galvanic battery we must, however, call attention to the two closely allied yet distinct forms of current capable of being generated by the batteries proper to each. They are *intensity* and *quantity*. By way of making a clear distinction between these two forms and in order to demonstrate their separate utility, let us imagine two streams of water taking their origin from two distinct subterranean reservoirs at the top of a mountain. The reservoirs are equal in dimensions and are capable of an equal water supply; they lie on the same level and the descent of their streams is similarly gradual throughout their separate courses until where they diverge to turn two water-wheels. Suppose that the orifice, through which one of these reservoirs feeds its stream, should become partly occluded. As a result the onward flow of its waters would in a proportionate degree be shut off. The accumulation of pent up waters would produce a pressure within the reservoir that in turn would cause the stream to gush forth with greater impetus and sweeping along would strike its wheel with much greater force, but lacking the volume of the other stream by reason of the occlusion at its source, would accomplish less work. So it is with the currents of the intensity and quantity batteries. The intensity, by virtue of its cell construction (the elements being smaller and alternately connected, and the distance between these elements and between the different cells being greater), like the stream impeded at its source, is resisted in its flow from one element to another and also from one cell to another (Fig. 2), so that it loses in quantity but gains in impetus or intensity. This is the form of Galvanic current employed in medical treatment.

The quantitative current, by reason of the proximity of elements, the great dimensions and exposure in surface of these elements, and the comparatively little resistance offered in its course, like the unimpeded stream, flows through the circuit in greater quantity and gives virtually more power when used for motor or heating purposes. It differs from the intensity current in that its volume, passing through the circuit at a given time, is greater and more uniform, while that of the latter is less, yet more violent in form.

If these two forms of the Galvanic current were successively passed through a cautery knife it would be discovered that while the current from the quantity battery would produce a white heat in the platinum blade, the passage of a current from an intensity battery would produce no perceptible effect and probably not even warm it. To explain this, let us again refer to our figure. Should the channels of both streams become similarly narrowed in their onward flow it is evident that the stream whose progress had thus far been unimpeded by reason of its greater quantity of water would be the more powerful, while the other, with far greater impetus, would again lack volume to be of any avail. In flowing through the cautery knife the quantitative current traverses a wire of less thickness, and besides, meets with still greater resistance in its passage through the platinum blade. As a result the current at this point is impeded in its flow, compressed into less area, rendered more compact, and hence heats the platinum point. The intensity current, however, lacking in volume, is not rendered sufficiently compact to even warm the blade, and it is only when this is passed through an intensely resistant and equally slender film (as of bamboo in the incandescent light) that the current will be sufficiently condensed to produce heat and light.

This explains the reason why we cannot have a battery that will serve both for medical and also for cautery purposes without change of cell construction. An intensity battery may, however, be converted into a quantity battery by connecting all the zincs of the different cells to one another, so also joining all the carbons, and finally closing the circuit by connecting the first zinc with the last carbon.

In the *storage battery* we have a method by which the electricity may be collected from a Galvanic battery and stored away for future use. This is accomplished by placing the battery into the circuit of a

number of intensity cells for a certain length of time when it will become charged, and on forming a circuit between its own elements a current is produced which is similar to that of a quantity battery. The cause of this change in the form of current lies in the fact of the absence of resistance; whence a voluminous flow results. As, should the waters of the impeded stream be shut off some distance from the wheel and allowed to collect in a reservoir in considerable quantity, on allowing it to resume its flow in such a way as not to be influenced by pressure from behind its original intensity or violence of flow would be lost, and should its waters escape in quantity as great as that of the other stream its power exerted upon the wheel would be none the less.

The storage battery is used for cauterizing purposes. It is composed of two sheets of lead cylindrically rolled, but so fixed that they do not come in contact with one another, and immersed in dilute sulphuric acid.

THE FARADIC CURRENT.

When a current from one or more cells passes around a bar of soft iron through an insulated wire it magnetizes this bar or helix by induction. This remains magnetized as long as the circuit is closed but is demagnetized immediately when the circuit is broken. Fig. 5 illustrates the construction of a Faradic battery from which we obtain the induced or Faradic current

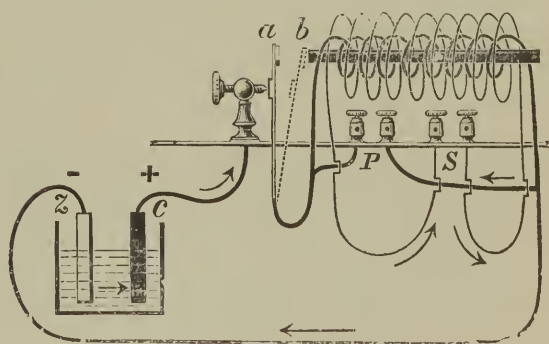


Fig. 5.

By tracing the current from the carbon element *c*, following the arrow up to the post, out to the point of the screw, and from there down the spring *a*, to which an insulated wire is attached that passes up and around the bar of soft iron and back to *z*, we have a closed cir-

cuit that immediately conforms the bar of soft iron into a magnet which attracts the piece of iron attached to the spring at *a* and draws it to *b*. In so doing it removes the spring from the tip of the screw (as is shown by the dotted lines) and breaks the circuit at this point. The circuit being broken the bar of soft iron once more becomes demagnetized, the induction in the coil of wire is destroyed, and the spring flies back to its former position. As soon as the spring strikes the point of the screw the circuit is again closed; but also, subsequently, as quickly broken when the bar of soft iron again becomes magnetized. Thus by the rapid making and breaking of the circuit a current is produced which takes the name of the induced, Faradic, or interrupted current, all of which are synonymous terms.

THE SECONDARY INDUCED OR FARADIC CURRENT.

If a second insulated wire is wound around this first or primary coil, but not connected with it, when the current is passed through the primary wire, at the same time a second current is generated in the superadded coil which flows through it in an opposite direction. As this second coil is entirely independent of the first so far as direct connection is concerned (the wire merely running from the right post *s*, around the primary coil and back to the left post *s*) the current is therefore produced by induction, and is known as the secondary induced Faradic or interrupted current. As compared with the primary it is much more intense and penetrating.

THE STATIC CURRENT.

This form of current is generated by friction.

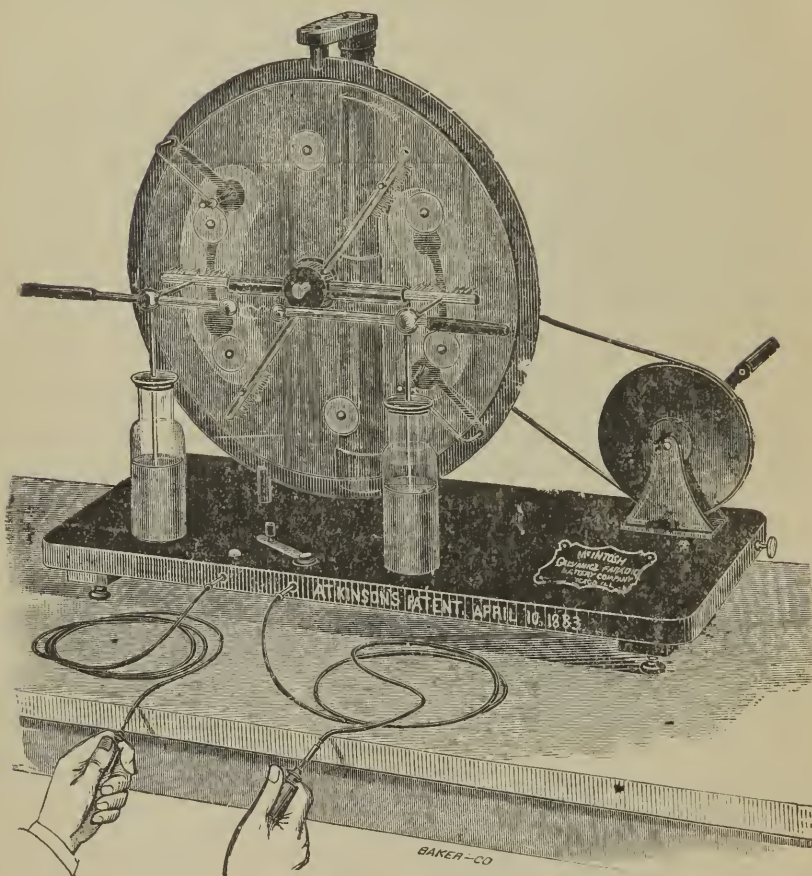


Fig. 6. The Static Machine.

Fig. 6 illustrates a machine devised for this purpose. It is so constructed that the positive electricity accumulates in the Leyden jar on the left and the negative in the other.

The current is one of very high tension and clothing offers but slight resistance to its passage; hence it is a form of electricity very convenient for administration, since it does not necessitate the removal of garments. There are several ways of administering it, as is shown in the following figures:

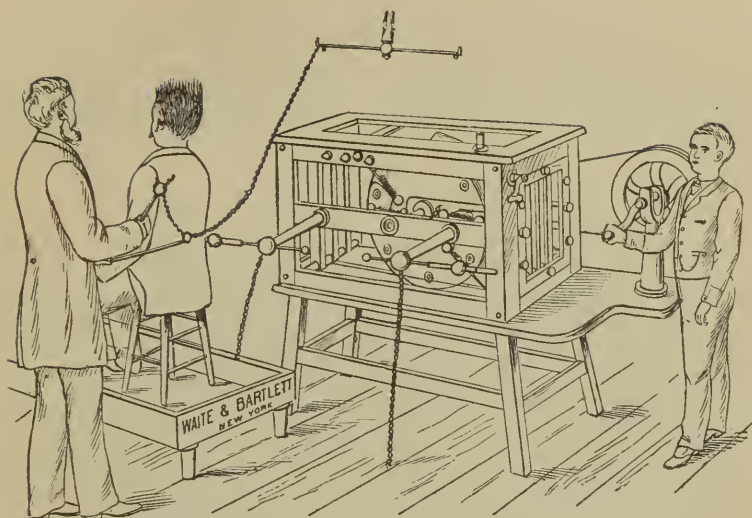


Fig. 7.—The Indirect Spark.

Fig. 7 shows the mode of giving the indirect spark. The patient is seated upon an insulated platform with which a cord from either pole of the machine is connected. A second cord is adjusted to a gas bracket that has connection with the earth, and to this is attached the electrode applied to the patient. In order to give this current the balls at the ends of the rods over the Leyden jars should be separated to their fullest extent so that sparks will not pass between them.

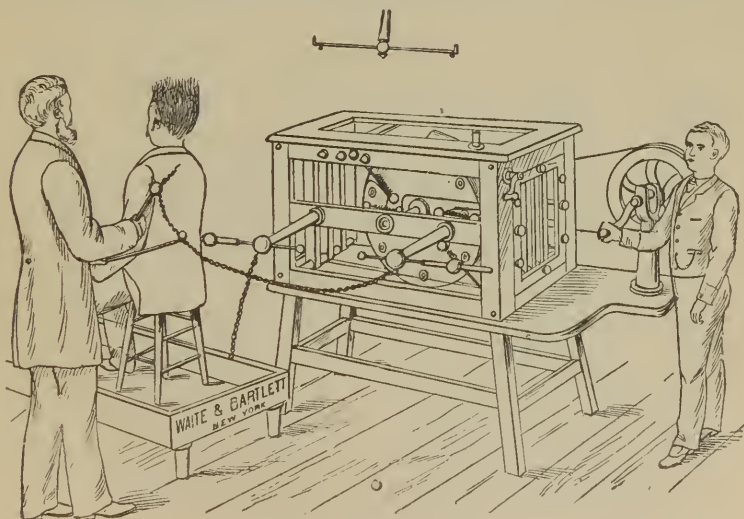


Fig. 8 The Direct Spark.

The direct spark (fig. 8) is applied by joining one pole with the platform by means of the cord as in the application of the indirect spark, but the second cord is attached to the other pole of the machine and thence applied to the patient by means of the electrode as before. Here also the balls must be separated as in the application of the indirect spark.

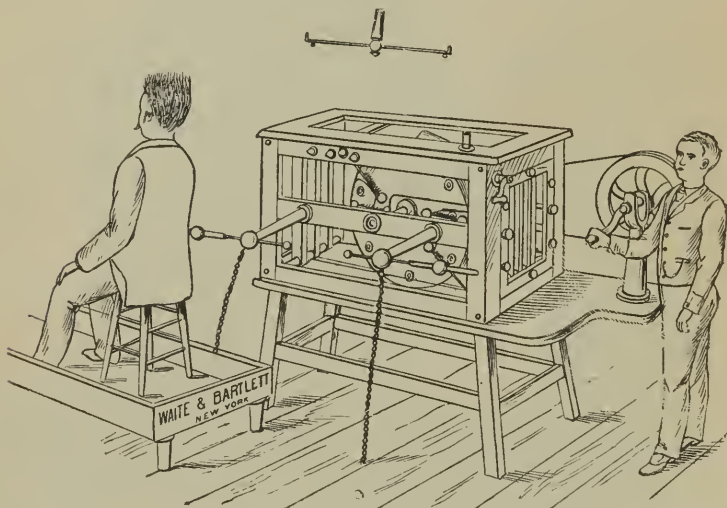


Fig. 9. Static Insulation.

Static insulation (fig. 9) is administered by connecting one pole with the platform and thus charging the patient either positively or negatively, as indications require.

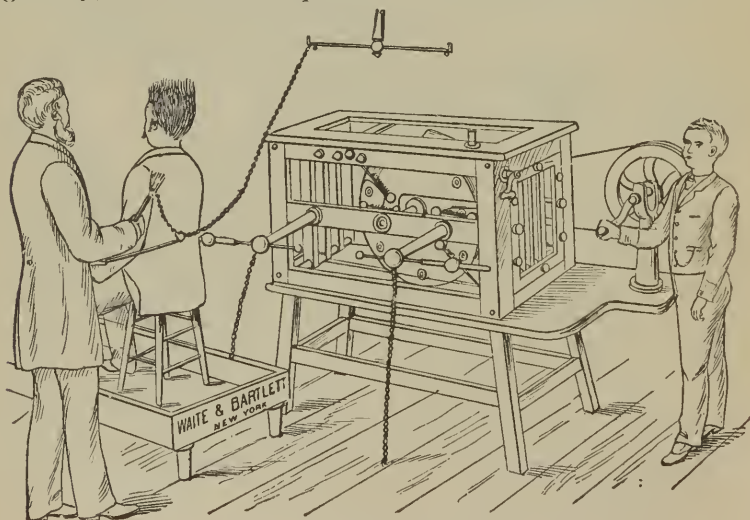


Fig. 10. The Indirect Static Breeze.

The indirect static breeze (fig. 10) is given by passing a sponge or pointed electrode connecting with a gas bracket close to the charged patient, so as to silently draw off the electric fluid. The current is imperceptible save a cooling sensation that is felt as the electrode passes over the body.

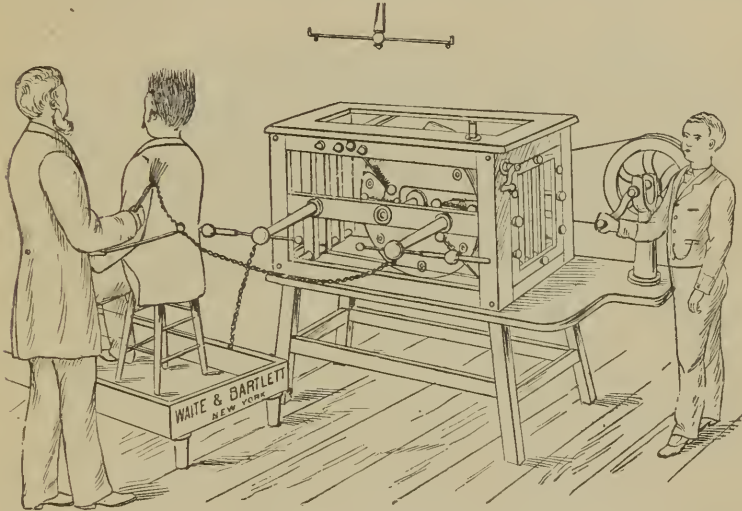


Fig. 11. The Direct Static Breeze.

The direct static breeze (fig. 11) is similar to the indirect, except that the cord which was attached to the gas bracket is fastened to the ball over the other Leyden jar.

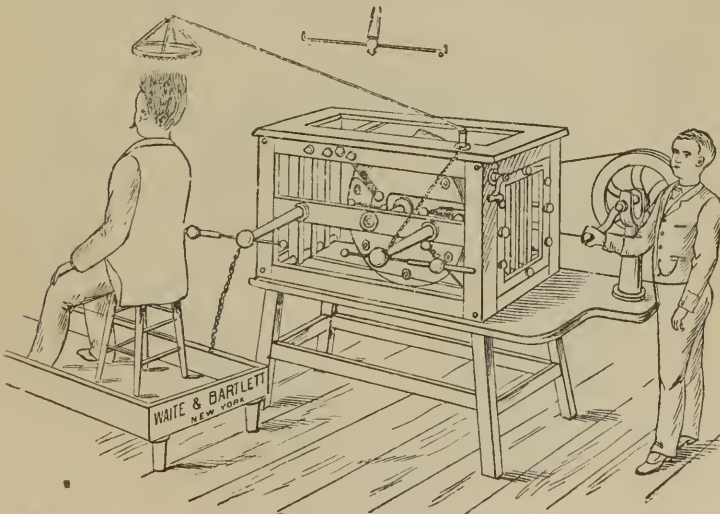


Fig. 12. The Electrical Head Bath

The electric head bath (fig. 12) is given by suspending over the patient's head a metallic cap, or "umbrella electrode," with points projecting from beneath at a sufficient distance to prevent the passage of sparks and still close enough to feel the electric breeze.

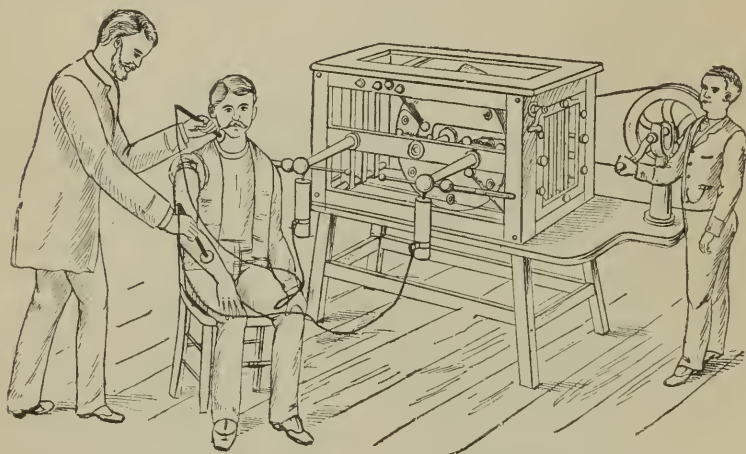


Fig. 13. The Static Induced or Morton's Interrupted Current.

The static induced or Morton's Interrupted current (fig. 13) is produced by hanging a Leyden jar upon each arm of the machine and attaching the conducting cords to the outer coating of the jar, instead of the poles direct as in the machines heretofore described.

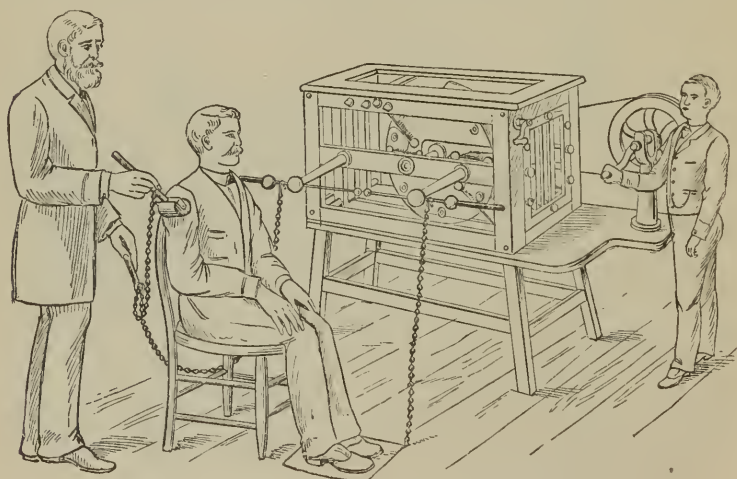


Fig. 14. Electro-Massage.

Electro-massage treatment is frequently administered with the static machine (fig. 14). It does not differ from the ordinary method of application except that, instead of the usual electrode, the massage-roller is used, and in this way electricity and massage are applied in unison.

UNITS OF MEASUREMENT OF CURRENTS.

Cells vary very much in regard to their strength or electro motor force, so that it would be very indefinite, in denominating the strength of a current, to speak of so many cells or such a cell power. In order, therefore, to express more definitely the strength of a current, certain units of measurement have been adopted. They are the Volt, the Ohm, the Ampere, and the Milliampere. The Volt is the unit of electro-motor force as represented in a Daniel cell, which is taken as a standard unit

The Ohm is the unit of resistance, and is equal to the resistance offered to the passage of the current in eight feet of No. 35 copper wire.

The Ampere is the unit of quantitative force ; or, the medical unit of electricity by which is accomplished a certain amount of work in a given time, just as the gallon per minute may be taken as the unit of a water current.

The Milliampere is the one-thousandth part of the commercial Ampere and is used as the unit of measurement.

The Milliampere-meter (fig. 15) is an instrument devised for the purpose of measuring any degree of the Galvanic current after its passage through the body.

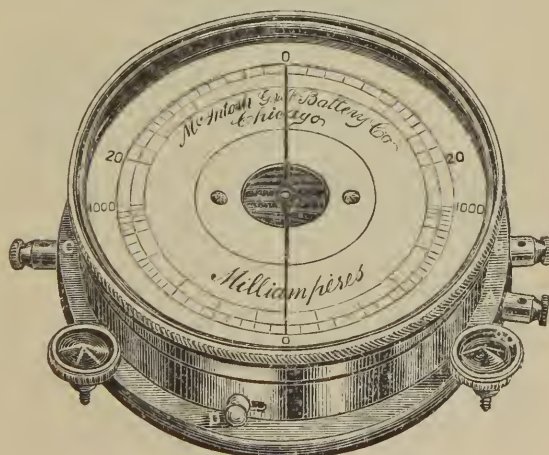


Fig. 15. The Milliampere-meter

There is also a great difference in the quality of current generated by both Galvanic and Foradic batteries. Very many batteries are annually sold to the profession and laity that are constructed upon a cheap plan and the currents of which are so intensely irritating and irregular that it is impossible to obtain any uniform results by their use. In fact there is as much difference in the quality of currents gotten from batteries constructed upon different principles as there is in the comfort derived from a well-made and carefully fitted shoe as compared with a cheap and inferior article.

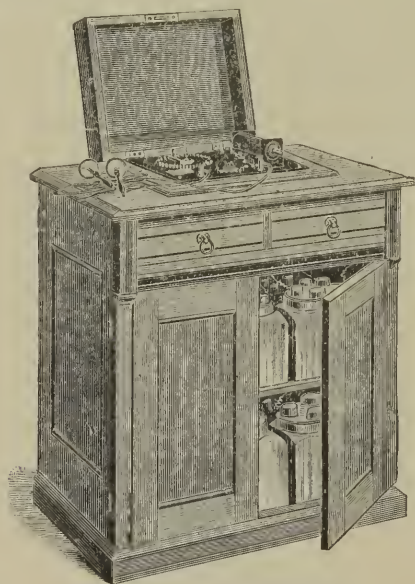


Fig. 16. The Office Battery.

Fig. 16 represents a combined table battery intended for office use. It is constructed of the best material and gives a smooth, gentle, primary and secondary Faradic as well as a Galvanic current. It contains all the accessories necessary for producing any modification of either of these currents, viz.: a current selector, by means of which any number of cells can be brought in o use without interrupting the current; a rheostat, capable of producing twenty-five hundred Ohms resistance, a galvanometer, to test the strength of current; a pole charger, and an automatic rheotome, which is used to interrupt the Galvanic current. In order to obtain positive results from a Galvanic battery it must have an electro-motive force of from fifty to one hundred Volts; and especially is this necessary in the treatment of paralysis and spinal troubles. In the absence of an automatic interrupter (which

is the case in some batteries) slow interruption can be made by alternately closing and breaking the circuit with the tip of the cord at the battery or electrode.

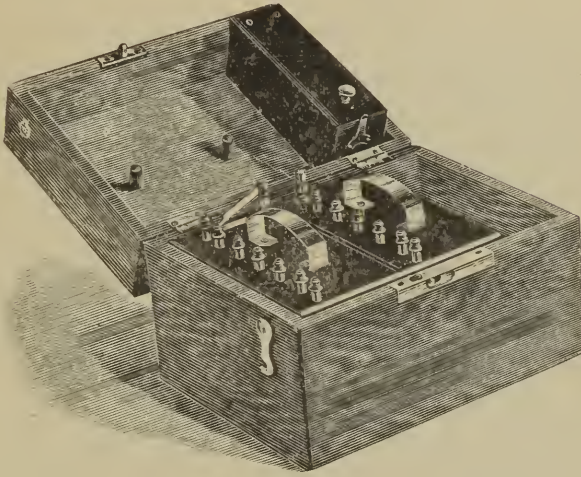


Fig. 17. The Portable Galvanic Battery.

Besides the office battery just described there are numerous small, portable batteries for both the Galvanic and Faradic currents, which on account of their size renders them very convenient to the physician.

Fig. 17 illustrates a Galvanic battery that may vary in size according to the number of cells it contains; while Fig. 18 represents one used for Faradic purposes alone.

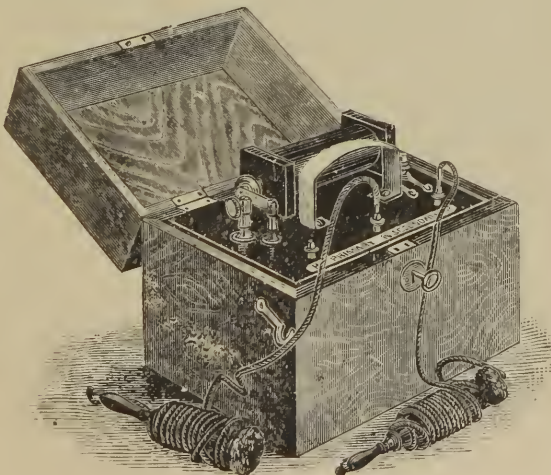


Fig. 18 The Portable Faradic Battery.

Combined Galvanic and Faradic batteries have also been devised, though single current batteries are preferable.

ANIMAL ELECTRICITY.

I have shown how any two elements differing in electric potential, on being disturbed by chemical action, will evolve electricity. This also holds good in the animal economy. All animal tissue contains various elements, differing in electrical potential, that are constantly being bathed in exciting fluids permeating the body, thus producing chemical charges, and hence necessarily generating electricity. This fact is no longer "sub judice," for electrical currents can easily be detected in muscles and nerves by means of the delicate astatic galvanometer. The electricity generated in the body is constantly being drawn off by the air and surrounding media, and in this way is prevented from accumulating to an abnormal extent. This process of depletion, by which the body is deprived of its electricity, is, however, dependent upon the conducting power of the surrounding media. As warmth and moisture greatly facilitate the conducting power of air it is evident that under a humid atmosphere the body is more thoroughly depleted than when surrounded by a dry and cool medium. That this does not account in part at least for the weary and inactive feeling experienced during the occurrence of damp and foggy weather cannot be doubted. Some animals are enveloped in coverings of so poor a conducting power as to prevent the rapid escape of electricity and by thus allowing its accumulation are capable of discharging it in shocks at will. Some persons even, under favorable condition, are able to impart a shock, while others when thoroughly charged and standing on an insulated carpet have been known to "light the gas."

PART II.—ELECTRO-PHYSIOLOGY.

Under this heading let us now briefly consider the influence of electric currents upon individual organs and tissues in health, from which subsequently important deductions may be drawn in regard to the application of currents in morbid conditions of the body.

If a Galvanic current of sufficient force is passed through a portion of nerve in its course the entire nerve is thrown into a condition of electrical tension that is known as electrotonous. In health the nerve excitability is diminished near the positive pole or anode, and this condition is called anelectrotonous; near the negative pole or cathode the excitability is most marked and this condition is therefore called catlectrotonous. If one pole be applied to the proximal extremity of a nerve and the other to its peripheral ending or over the group of muscles to which its filaments are distributed, on closing and breaking the circuit there will be contraction of all the muscles that are supplied by this nerve. This fact suggests the existence of an intimate relation between electricity and nerve force which can be further demonstrated by passing a current through a nerve that has been cut and consequently its communication with the brain destroyed, for in this case also will muscular contraction take place as though the nerve were intact.

EFFECTS OF THE GALVANIC CURRENT.

The anode or positive pole of the Galvanic current is soothing in effect, will relieve pain, contract capillaries, and act as a hæmastatic; while the cathode or negative, when attached to the operating electrode, is irritating in effect, will produce pain, dilate capillaries and induce hemorrhage. Hence, in applying the current an active and an indifferent polar effect should always be taken into consideration. The active pole should be applied where it is desired to produce a specific effect, while the indifferent pole (usually a broad sponge or an Apostoli clay electrode (Fig. 19), so as to spread the current over greater area and consequently render it inactive at that pole) should be referred to some remote part of the body. For example: Should I wish to allay

spinal irritation and produce capillary contraction, I would apply the anode to the spine and the cathode to the hands or feet.

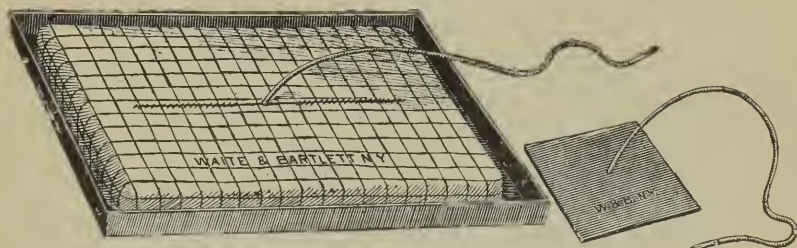


Fig. 19. Apostoli Clay Electrode.

The effect of the Galvanic current upon the cutaneous system manifests itself at first by producing a slight pricking sensation which subsequently, if allowed to remain for any length of time, becomes a burning feeling and causes the skin to assume a red hue. This occurs if either the anode or the cathode be the active pole.

The Galvanic current has some effect upon nutrition by inducing chemical action, but to much less extent than the Faradic. The same may be said concerning its application to the ganglia of the sympathetic nervous system

Chemical Effects: This current has the power of decomposing chemical compounds both within and without the body and breaking them up into their original elements. This can be demonstrated by passing it through a solution of potassium iodide when iodine will appear at one pole and potassium at another. So also may water be decomposed into its two elementary gases. This property renders the current of great value both in eliminating poisons from the system and also in overcoming the senile deposit of earthy salts, as will be seen in the subsequent discussion on the uses of the electric bath.

EFFECTS OF THE FARADIC CURRENT.

What has been said of the Galvanic in regard to its electro-physiological properties may also be applied to the Faradic current, except that the latter is devoid of chemical decomposing powers, possesses greater tonic properties, favors assimilation more markedly and is a more decided nerve stimulant than the former.

EFFECTS OF THE STATIC CURRENT.

The Static current differs from the two preceding forms in that it produces no marked muscular contractions and is more irritating and exciting to the skin, muscles, and nerves when applied, as it usually is, by means of the spark. However, when applied by the Morton's interrupted or induced method (fig. 13) muscular contractions are very perceptible, and the intensity of these contractions are in direct proportion to the distance between the rods over the Leyden jars.

ELECTRO DIAGNOSIS.

The use of the dynamic current has assumed a position of considerable importance of late years in locating central and peripheral nerve lesion, as well as determining whether the impaired function of an organ is due to a perverted nerve supply or to some morbid condition in the organ itself. The capability of making a diagnosis in nervous diseases by means of electric currents is based on the fact that a change of polar reaction and sensibility to current, differing from the normal in comparison to the extent of the lesion, is produced whenever the peripheral or central nerve is in a morbid condition.

In order to procure positive results in diagnosis as well as in treatment, the physician should be thoroughly familiar with the uses of the different currents; and, again, keep the batteries in good working order so as to be sure of having a perfectly uniform current. In order to distinguish between the anode and cathode, to reverse them at will, and to test the strength of current with accuracy, the pole tester, commutator, and milliampere-meter are indispensable accessions to a battery used for diagnostic purposes. When it is desired to test an individual part or nerve, small electrodes must be attached to the active pole in order to prevent adjacent parts from being influenced. The indifferent pole must be large and at the same time should be placed over some remote part of the body where it cannot influence the active pole; as over the sternum, nape of the neck, or feet. It must be remembered that there are marked differences in individual response to the action of a current; so much so that the effects upon one person cannot be taken as a criterion by which to diagnose the existence of a morbid condition in another upon whom its effects are less marked. For this reason the healthy corresponding parts of the patient should

first be tested and afterward compared with the unhealthy in order to confirm a diagnosis. The skin of some patients offers greater resistance to the passage of the current than that of others, in order to overcome this the sponge electrode should be immersed into a warm saturated solution of sodium chloride; or metallic electrodes may be substituted. Both the Galvanic and Faradic currents may be employed, although the former is the more reliable.

For diagnostic purposes in paralysis there are three strengths of current used, viz: the mild, medium, and strong. There are muscular contractions produced only on closing and opening the circuit. In the application of these three strengths of current to a normal subject the following phenomena will be presented: If the inactive pole be placed over the sternum or nape of the neck and the active along the course of the nerve, on passing the mild current, if the active pole be positive no opening or closing contractions will take place; but if it be made negative there will be a contraction of muscles on closing the circuit which is called cathodal closure contraction (c. c. c.). In the current of medium strength, if the active pole be positive, there will be a contraction on closing the circuit—the anodal closure contraction (a. c. c), and another on opening it—the anodal opening contraction (a. o. c). In the strong current, if the active pole be negative, there will be cathodal opening contractions (c. o. c). In health, therefore, the c.c.c. being present in the mildest current exceeds the a. c. c., while the a. o. c. exceeds the c. o. c. In diseases, however, where there is both nerve and muscle degeneration, there is increased response that causes the a. c. c. to exceed the c. c. c. and the c. o. c. to exceed the a. o. c.

In degeneration of nerve fibres alone, there is merely a loss of excitability; while in degeneration of muscle alone the excitability of the nerve will be preserved, while that of the muscle will be lost.

PART III.—ELECTRO-THERAPY.

After having familiarized ourselves with the different modes of generating electricity, the different forms under which it appears, and the effect of these various forms upon healthy organs and tissues of the body, let us now consider its effect upon the numerous structures of the human economy when invaded by pathological processes and ascertain what form and what method of application is best adapted to the treatment of these morbid changes.

MODES OF APPLICATION.

As a medico-therapeutical agent electricity may be applied in five general ways; besides a number of special ways worthy of mention. The general methods are localized and general Faradisation, and general and central Galvanization.

Localized Faradisation is used whenever we wish to produce a tonic effect upon any group of muscles or nerves, or any individual structure; as, in paralysis of a nerve or muscle, or atony of an organ.

General Faradisation is used whenever we wish to produce a general tonic effect throughout the economy—to promote assimilation and tone up the general system.

Localized Galvanization is employed, either to relieve pain in any part (by means of the anode) or (by means of the cathode) to excite parts, and also, by interrupting the current, to produce muscular contraction or arouse the activity of a sluggish organ.

General Galvanization is given to produce changes in the blood and various tissues of the body, and also for the purpose of eliminating poisons by decomposing and attracting them to the different poles.

Central Galvanization is the application of the Galvanic current to the brain and spine for the purpose of allaying irritation, relieving congestion, and modifying the changes that are occasioned by various morbid conditions.

SPECIAL ELECTRODE.

For the purpose of making these different applications special electrodes are necessary ; as, the large hand sponge for diffusing the current, small sponges to concentrate the current, roller electrodes for electro-massage treatment, foot plates and spinal electrodes, (Fig. 20)

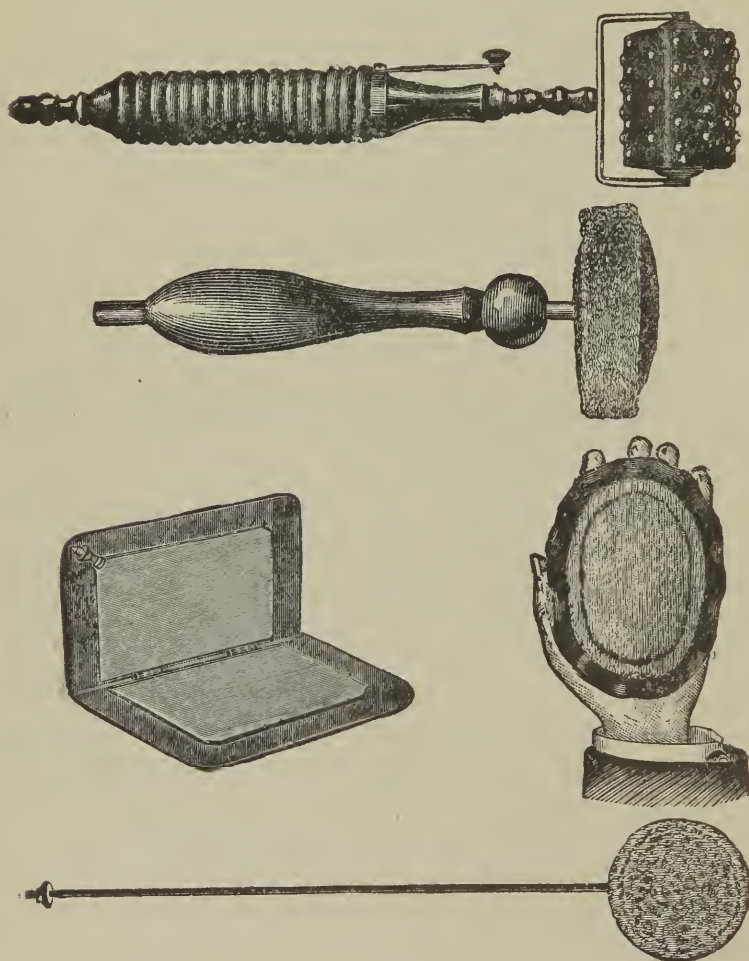


Fig. 20.

arm, neck, eye, ear and scalp electrodes, (Fig. 21),



Fig 21

and the different vaginal and rectal electrodes. (Fig. 22).

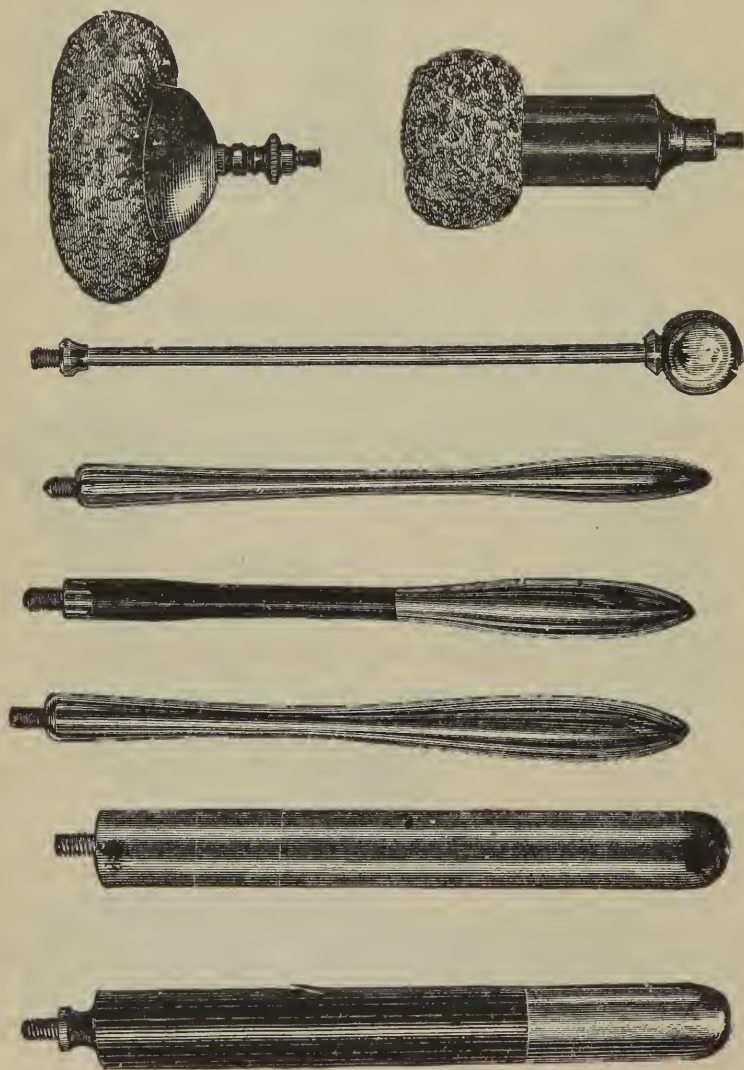


Fig. 22.

The urethral and uterine electrodes (Fig. 23) are also used in electrolysis.

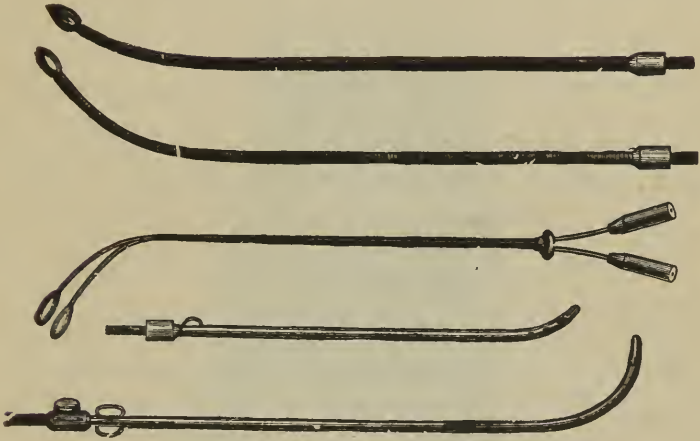


Fig. 23



Fig. 24.

For the administration of the Static current, owing to its high tension, special electrodes (Fig. 24) with vulcanized rubber handles must be used in order to protect the operator.

THE ELECTRIC CABINET VAPOR BATH.

One of the most advantageous methods of applying the electric current for both local and general Galvanization and Faradisation is by means of the *Electric Cabinet Vapor Bath* (fig. 25).

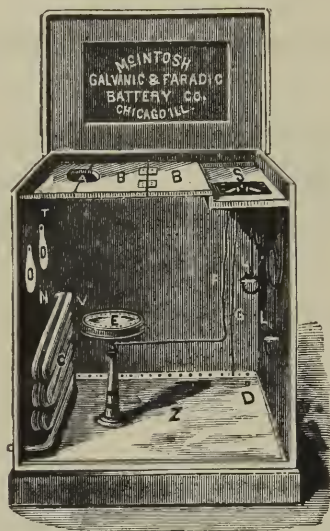


Fig. 25. Electric Cabinet Vapor Bath.

It consists of a closed box with a folding and sliding cover (BB), an opening for the patient's neck (A), a seat fitted with a metallic electrode (E), hand (L), back (N), and feet electrodes (Z), and a steam coil (C) for heating purposes. The switch-board (S) is so arranged that the current can be made to pass to any of these electrodes at will of the operator, and hence also be passed through any part of the body desired. As; by causing the current to flow through the hand and back electrodes by either raising the revolving seat to the desired height or raising and lowering the back electrodes, and by applying the table hand electrode to the anterior part of the body, the current can be made to pass directly through the liver, spleen, uterus, or any of the viscera. Or, by allowing the current to pass through the hand and feet electrodes, it may be employed for general Galvanization or Faradisation.

Besides these advantages offered by the cabinet method of applying the current, the addition of a hot air or steam apparatus, so arranged

that a hot air or steam vapor bath can be administered in conjunction with the electrical treatment, renders this method of two-fold importance. Especially is it indicated in diseases due in great part to an over-acidity of the blood; as, in some forms of rheumatism, in the lythaemic and uraemic diatheses, in bilious conditions, and in other morbid states of the blood due to the accumulation of poisons, as in malarial fevers. In this way, by arousing the skin to activity through profuse sweating and by stimulating the sluggish organs to a proper performance of their functions with the electric current, thus eliminating the poisons from the blood, is furnished us one of the best methods for overcoming these poisoned conditions of the system.

THE ELECTRIC TUB BATH.

This is given by placing the patient into a tub of water through which is passed either the Galvanic or the Faradic current. In order to successfully charge the water and to prevent the escape of electricity the tubs must be made of non-conducting material. Wood will hardly answer the purpose; for, if the water is allowed to remain in a tub of this material any length of time it will become saturated and in consequence lose its non-conducting properties. Porcelain lined metal tubs have been devised for this purpose, but they are objectionable because the action of hot water will soon cause the coating to crack, and, by the accumulation of foreign matter in these crevices, prevent the strict hygienic precautions that should necessarily be exercised in this mode of treatment. This is also applicable to tubs of solid porcelain. Soap-stone, though quite expensive, is by far the best material in all respects. It is impervious to fluids, can be more thoroughly cleansed, and is not affected by hot water.

The electrodes, in the shape of broad metallic plates, are placed at either end of the tub so as to equally diffuse the current throughout the volume of water and hence, necessarily, charge its contents and producing an equal distribution of electricity throughout the whole system.

This is one of the best methods of applying the current to the entire surface of the body, and is indicated in conditions where the current is applied for promoting assimilation, aiding osmosis, and producing chemical changes.

Applied in this way the current has a soothing effect upon the nervous system, equalizes the circulation, and, besides, has a decided tonic effect upon the cutaneous system.

In certain cases, especially cutaneous diseases, this mode of treatment may be greatly augmented by adding to the water suitable medicinal agents, which, by aid of the current, will be much the more readily absorbed.

Under certain conditions it is well to use the cabinet and tub conjointly, so as to obtain the individual benefits of either.

TREATMENT OF SPECIAL DISEASES.

DISEASES OF THE BRAIN AND NERVOUS SYSTEM.

In the treatment of morbid condition of the brain, the Galvanic current is preferable to the Faradic on account of being more penetrating and more easily over-coming the resistance offered by the cranium, and also, because of its distinctive polar and electrolytic effects.

The current produces its effects upon the brain by influencing the circulation and by chemical changes. There are two ways of influencing the circulation, viz: the direct and indirect methods.

In the direct method the current is passed directly through the brain either antero-posteriorly or laterally. In hyperaemia, or congestion, the anode is applied to the forehead, while the cathode is placed over the nape of the neck. To increase the flow of blood to these parts the poles should be reversed. In thrombi or hemor-

rhagic effusions the polar effects should be brought to bear directly upon the affected part as in figure 26.



Fig. 26.

In the indirect method the circulation throughout the brain is effected by applying the poles to the sympathetic ganglia of the neck. Stimulation with the negative pole will cause vaso motor contraction and relieve congestion.

In the application of the current by this method however the sympathetic ganglia are not alone influenced, but the pneumogastric and other neighboring nerves are also notably affected.

In passing the current through the brain by either of these methods, great precaution should be observed that neither too strong an application be made nor the current be allowed to flow for any length of time. The strength of current should not exceed three milliamperes to begin with, but may be gradually increased to near the point of tolerance which is generally marked by slight nausea and dizziness. The length of time devoted to a single application should vary from three to five minutes, and whenever any discomfort is experienced the treatment should immediately be discontinued.

CASE I. — Congestion of the Brain: Male, forty-five years of age, and a traveling salesman by occupation. Had been in perfect health up to within a year of consulting me. At that time he began to suffer from restlessness at night accompanied by a heavy uncomfortable feeling in his head. He consulted a physician, who prescribed strychnine for him. Becoming worse, he sought the advice of another who put him upon potassium iodide, although there was no history of any prior venereal disease. He continued growing worse from the

time he was taken until I saw him. On examination I found a general paresis of the entire body and ptosis of the left eye-lid, though he was suffering no particular pain. He always arose of a morning feeling tired, even when he had slept soundly all night, which, however, was seldom.

He was extremely sensitive to both currents and could not bear the use of the Faradic at all. I began by galvanizing the cervical sympathetic for five minutes with a mild current of three milliamperes, having the cathode over the nerve and the anode along the spine. In consequence of this first application he slept better the following night and arose feeling less tired. I gave him the same treatment the following day, but increased the current to five milliamperes and applied it for ten minutes. This caused an unpleasant drawing sensation in the hypogastic and left hypochondriac regions, and on returning the next morning he complained of not feeling so well, and it was with great difficulty that he could hobble into my office, though supported by two canes. I made another application of three milliamperes for three minutes only, and found him much better on the following day. I continued this mild application for a month with marked success; after which, he was given the electric cabinet vapor bath with both central Galvanization, and very mild Faradisation over the stomach, bowels, and limbs. He improved steadily and in three months was able to walk with very little difficulty; the ptosis also was entirely relieved. Though his abdomen was very much distended with gas, and he suffered greatly from indigestion and diarrhoea when he first came to me for treatment, in a short time these symptoms also disappeared. At the end of four months, further improvement seeming to be at a standstill, the treatment was discontinued for several weeks. On resuming it rapid improvement was again manifested, and by being treated in this manner at regular intervals he was enabled to resume his business, though he never entirely recovered.

PARALYSIS.

In the treatment of paralysis, it is of great importance to ascertain whether the disease is due to either encephalic, spinal, or peripheral nerve lesions in order to make a proper application of the current.

As a means of correct diagnosis the method by electrical reaction yields by far the most positive results.

Paralysis due to encephalic lesions is usually confined to one side of the body (as hemiplegia), while that due to lesions in the spine usually affects the lower extremities. Peripheral paralysis is restricted to the group of muscles to which the affected nerve is distributed.

Affections of the central axis are frequently the result of peripheral irritation; and in such cases the cause must be removed before permanent relief can be procured by this treatment. Prominent among these causes we may take for example preputial irritation in children, in which the local causes producing the paralysis must first be removed, usually by circumcision, before any beneficial results can be derived from the application of electricity.

CASE II.—*General Paralysis*: Male, aged seventeen; was sent to me from Dyer, Tenn., March 25, 1887. In September, the year previous, he had an attack of cerebro-spinal meningitis-endemic in that locality. On recovering from the acute symptoms partial paralysis of the whole body was observed, the lower extremities being much the more severely affected. This gradually grew worse until when brought to my office he was unable to walk unless supported by two canes, and even then could not close his eyes without falling. There was tenderness on pressure of the vertebra prominens, slight tendon reflex, slight ankle motion, but entire loss of motion in his toes; marked anaesthesia of both lower and upper extremities; pupils dilated. Electrical reaction, and physical signs, both located the trouble in the brain and spine.

I applied general Faradisation, and labile Galvanization to the spine in conjunction with stable Galvanization to the head.

This treatment was continued daily for a week, when slight improvement of health was observed, but no perceptible change either in locomotion or movements of feet or toes had been effected. On April 3d I began using a thirty milliampere interrupted Galvanic current by applying the cathode to the feet and the anode along the spine. Immediately after this treatment he was able to move the great toe of the right foot. After the second treatment in this way he recovered motion of three toes of the same foot. This method was continued for a week, but in the meantime the strength of current had gradually been increased to eighty milliamperes, which was as much as he could bear without pain. At the end of this time there was considerable improvement in locomotion, and he could move the toes of both feet.

I then began giving him general Faradisation with interrupted Galvanization regularly every day for six weeks, after which he was allowed to go home and remain two weeks. He returned and remained under treatment a month longer. During the whole of this time, even while at home, he continued improving, and when dismissed was able to walk with very little difficulty. He returned home and I did not see him again for six months, when one day he visited me entirely relieved.

I have dwelt upon this case at length because paralysis following meningitis is generally regarded as being incurable, and the family had been told this by their physician.

CASE III.—*Hemiplegia*: Male, aged twenty-eight; habitual drinker. Following one of his drinking bouts he suffered an attack of hemiplegia of the right side accompanied by aphasia. I diagnosed hemorrhagic effusion, and used all currents and medicines known to science, but with no avail. He improved notably in general health, and even became able to write legibly, but his speech and locomotion were very little improved.

I attributed the failure of establishing a cure in this case as being due largely to the fact that treatment had been deferred too long for electricity to be of any value; since he did not come under my care until a year after the trouble had occurred.

For a long while it was regarded as being wrong to treat paralysis with electricity until after all acute symptoms had subsided. It is now, however, generally conceded that treatment should not be deferred too long, as a cicatrix or cyst may form in the site of the lesion which subsequently cannot be affected by any method of treatment.

CASE IV.—*Hemiplegia, Due to Preputial Irritation*: In January, 1887, a boy, aged eleven years, was brought to me to be treated for a dragging of the left foot in walking. A thorough physical examination revealed the fact that his right arm was also impaired. On seeking for the cause, I discovered that he had an adherent prepuce. I advised circumcision, to which the parents objected, because they could not see how this could cause such trouble. After some explanation however, they assented to an operation in which I merely broke up the adhesions with a probe, after which electrical treatment was begun

by using both Galvanic and Faradic currents. There was some improvement for the first month, after which no progress could be discovered. On examination I found that the prepuce had again formed an adhesion with the glans. The parents now consented to circumcision and the operation was performed February 18, 1887. There was union partly by first intension and partly by granulation. On March 1st electrical treatment was again begun by the use of central Galvanization and general Faradisation. Rapid improvement followed and by April 15 the cure was complete.

CASE V.—*Paralysis Due to Preputial Irritation*: Male, aged nine years; had suffered from incontinence of urine since childhood. He had always been delicate in health and dyspeptic. At the age of seven the mother noticed slight impairment in the movement of the right leg and arm and also that the entire right side lacked in development. On May 7th I examined him and found a very irritable glans penis with adhesion of prepuce. Circumcision was performed, after which I pursued the same electrical treatment as in the preceding case. In three months he was discharged strong and robust.

CASE VI.—*Infantile Paralysis*: Girl, five years old; small for her age and exceedingly dull and listless. Had been perfectly well up to her second year, when she was taken sick with some form of fever while teething. Both upper and lower extremities became impaired to such a degree that she subsequently made no attempt to walk. Prior to her illness she had begun to talk, but at the time I saw her she was merely able to utter a few indistinct sounds. Her bowels were very costive and required large doses of strong purgatives to move them.

I began treatment by applying the large and stable Galvanic electrodes to the brain and spine in conjunction with general Faradization. The child improved very rapidly and in the time of three months was able to walk about the room and had begun to talk. The treatment was continued at irregular intervals for more than a year and was followed by complete recovery.

In applying the current to children it is best to have a metallic foot

plate covered with a wet towel placed in the mother's or nurse's lap and allow the child to be seated upon it, while the other pole may be applied to the head, spine, or wherever indicated.

Children and young people suffering with paralysis respond to electrical treatment much more readily than do old or middle aged persons. I have treated a number of patients similar to the preceding cases with equally good results—except in cases of imbecility.

CASE VI.—*Paraplegia*: Male, aged thirty-one, a lawyer by profession; of dissipated habits. While preparing an argument for the Supreme Court of the United States he was suddenly stricken with paralysis of the lower muscles. For several months he was unable to move his legs.

He received daily treatment by application of the interrupted Galvanic current in conjunction with the Faradic and at the expiration of four months was entirely restored.

CASE VII.—*Paralysis Following Labor*: Female, aged twenty-three; was delivered of child April 2, 1884, immediately after which it was discovered that she could not move her lower limbs. She was brought to me for treatment the following October. I found her in perfect health with the exception of complete motor and slight sensory paralysis of her lower extremities. Both Galvanic and Faradic currents were applied to the impaired limbs in daily treatments for a month. This was followed by slight improvement, but becoming discouraged with the slow progress she was making, discontinued her visits to my office and returned home. I did not hear of her for several months, when on meeting her husband one day he informed me that she had just been delivered of a child and that, though no anaesthetics were used, the labor had been entirely painless.

CASE VIII.—*Paraplegia*: Female, aged twenty; had suffered with pain in her back and disturbance of menses since puberty. At nineteen had a miscarriage and shortly after that was brought to me with complete loss of motion in her lower extremities. Examination revealed hyperplasia of the cervix uteri with retroversion. The uterus being replaced, I introduced into the cervix three needles attached to the cathode while she grasped the anode with her hand. The Galvanic

current was used and gradually increased from one to twenty milliamperes. The application in this manner was made for from three to ten minutes at varied intervals and in conjunction, Galvanization and Faradisation of the spine and lower limbs were daily given. On examining the cervix at the expiration of four days it was found to be much less indurated. The small broaches or needles were again introduced and a current strength of ten milliamperes applied. In six weeks she was able to walk to my office, a distance of half a mile. The treatment was continued for four months and followed by complete recovery.

CASE IX.—*Paralysis Agitans*: Lawyer, fifty-three years of age; was in an advanced stage of paralysis agitans that had been of two years standing.

By the use of central Galvanization and general Faradisation he was enabled to rest more comfortably and for a time gained strength. His life was evidently prolonged for some months by this treatment though no decided effects could be produced.

This form of paralysis occurring, as it usually does, in advanced life, presents a very unfavorable prognosis. The electric currents may give considerable relief and make life more tolerable though seldom produce a cure.

As it owes its origin most likely to some intra-cranial disturbance the Galvanic current should be applied directly to the brain, while general Faradisation should be employed with a view of obtaining its tonic effects upon the system as a whole.

DISEASES OF PERIPHERAL NERVES.

On account of the exposure and diversified distribution of the peripheral nerves, affections are more common and of greater variety here than in the central axis, yet the diagnosis can usually be made with greater ease because of the limited distribution of each individual nerve.

The prognosis in these conditions is by far more favorable than in those heretofore mentioned, though, owing to their intimate relation to the brain and spine, morbid affections may exist in both places simultaneously and hence render more grave the prospect of recovery.

The principal diseases of peripheral nerves are paralysis due to traumatism, poisons, or numerous other causes, neuritis, and the different neuralgias; the symptoms, diagnosis, and treatment of which will be demonstrated in citing the cases.

CASE X.—*Paralysis of Portia Dura of Right Side:* Female, aged forty. She had suffered from neuralgia and various nervous disturbances for ten years prior to the attack of paralysis. When she applied to me for treatment her mouth was disfigured and her face very much distorted.

The Faradic current was applied, by placing one pole over the place of exit of the nerve and the other over the paralyzed muscles. This was continued for ten minutes, after which the interrupted Galvanic was used in the same way and for the same length of time. Improvement began at once and after two months' regular treatment, by daily applications, she was almost entirely relieved. Subsequently she received treatment but twice a week, and in a short time was perfectly well.

CASE XI.—*Lead Paralysis:* J. B., a farmer fifty-three years of age; habitual drinker. On June 5, 1887, after recovering from the effects of a drinking spell he noticed that he had lost the use of one of his hands. On examination I found that there was perfect "wrist drop," simulating lead paralysis to a marked degree. Interrogations as to exposure to lead poisoning revealed the fact that he had recently moved into a freshly painted house. As the colicky pains were absent, and the lead line on the gums not very marked, he doubted my diagnosis and thought it entirely due to drink.

The currents were however applied and in two weeks he had wholly regained the use of his hand.

CASE XII.—*Lead Palsy:* Male, aged thirty-three; carriage painter; came to my office July 7, 1887. For about a year he had been troubled by his wrists giving out while working and lately had been suffering with almost daily colicky pains. His right wrist was tender and slightly sore, due, as he thought, to his efforts to continue working while in this weak condition.

I prescribed potassium iodide and saline cathartics followed by opiates to allay the colicky pains as internal treatment, and first made a direct application of both Galvanic and Faradic currents to the arm and

hand. Subsequently I made an indirect application of the secondary Faradic current for twenty minutes, immersing his hand into a porcelain basin of warm water and placing the poles on either side of it. This I found gave him more relief than the direct application of the currents. His improvement was very slow, for the reason, probably, that during the whole of the treatment he was compelled to continue work in order to support his family. The treatment was continued daily for three months; at irregular intervals for eight months longer; and followed by complete recovery.

CASE XIII.—*Lead Poisoning*: Sign painter, aged twenty-eight; had been pursuing this occupation since he was eighteen years of age and had suffered from lead colic almost constantly. At the time he came under my observation his gums showed the characteristic hue of lead poisoning; his complexion was swarthy; had marked "wrist drop," and complained of becoming fatigued on the slightest exertion. He also suffered from frequent attacks of insomnia.

I prescribed potassium iodide and saline cathartics as internal treatment, though the former disturbed his stomach to such a degree that it became necessary to discontinue it shortly afterward. Daily applications of local and general Faradisation were made, but he improved so slowly under this treatment that he became discouraged and was about to discontinue when I induced him to take the electric tub bath, by means of which was administered both the Galvanic and Faradic currents, the former of a strength of fifty milliamperes, sufficient to cause the experience of a metallic taste for several hours after the bath. He improved after the first bath and in four weeks was entirely relieved.

WRITERS CRAMP OR SCRIVENERS PALSY.

This form of paralysis applies to a class of diseases where, by the constant use of a single set of muscles to the exclusion of others, there is produced a functional loss of power in that particular group. As a general rule there is no other trouble, and the patient may be in a state of perfect health save the impairment of the functions of that particular group of muscles upon which, frequently, he is dependent for his livelihood. This affection is not alone common among writers, but also among telegraphers, piano-performers, and compositors.

CASE XIV.—*Writers Cramp*: A registrar of deeds, aged thirty-five; had held the position for four years and did most of the work himself.

The first sign of existing trouble appeared to him about two months before consulting me, at which time he noticed that after writing for several hours his task became more laborious and would necessitate him to hold his pen differently. Later on he found, that in order to prevent its falling from his hand, he was compelled to grasp it more firmly. Finally his hand became so feeble that in writing he would have to steady it with the left. As his livelihood depended upon his writing he continued in this way until the muscles of the forearm, and later the whole arm, became impaired.

I began treatment by applying the Faradic and interrupted Galvanic currents to the whole arm and spine, and at the same time advised him to discontinue work for a time at least, which, however, he refused to do.

At the end of the first week there was some improvement, though very slight. I continued the treatment, and in addition advised him to exercise with Indian clubs twice a day so as to bring into action a different set of muscles. From that time on he began to improve rapidly, and after continuing treatment in this way for nine months was entirely relieved of his trouble.

CASE XV.—*Telegraphers Paralysis*: In April 1888, an operator belonging to the Associated Press, applied to me for treatment. He complained of his arm becoming stiff after using it for several hours, so much so that he could not send a message without frequent “breaks.” Said he had been taking a great deal of gymnastic exercise within the last year, which at first seemed to benefit him, but that lately it had lost its effects.

I began the application of both the interrupted Galvanic and Faradic currents to his arm and hand, and advised him to continue gymnastic exercise to a moderate degree.

Improvement followed the first application and after a month’s treatment he had no further trouble.

NEURALGIA.

Neuralgia is the term applied to the morbid condition of a

sensory nerve in which pain is a characteristic symptom, yet where no perceptible pathological change in the brain, cord, or nerve substance itself can be recognized. The etiology of this pain may be due to either reflex irritations, atony of the nerve itself, impoverished conditions of the blood, or spring from inherent conditions as yet unknown. Generally the pain throughout the nerve or part of nerve affected is not uniform, but there are tender points (*puncta dolores*) where the pain is more intense. The nerves most frequently affected are the trigeminal, great sciatic, and intercostals.

Besides the neuralgic affection of nerve trunks and their branches, visceral neuralgias may also be classified under the category of diseases in which electrical treatment is of greatest benefit; especially is this the case in uterine and gastric neuralgias.

TRIGEMINAL OR FACIAL NEURALGIA: On account of the extensive distribution and exposure of this nerve it is more frequently affected than any other. The great exposure of the ophthalmic division, by its numerous ramifications over the face renders its separate terminal branches a frequent seat of neuralgia; so also with the superior and inferior dental in decay of teeth, where the delicate nerve endings become exposed.

CASE XVI.—*Facial Neuralgia:* Female: suffered with excruciating pain in the mental division of the inferior dental which was increased to such an extent while talking or eating that she was compelled to remain perfectly quiet and live on a soup diet for six months. She had several teeth extracted with a view of removing the cause, but all to no avail. Following this she applied to me for treatment. I applied the Galvanic current with the anode over the mental foramen, and in connection with this used the static, applying it with the Douchennes points. In the course of three weeks she was entirely relieved of her trouble.

CASE XVII.—*Supra-Orbital Neuralgia.* Male, aged thirty-three; family history revealed a neurotic tendency, hereditary on his mother's side. When he came to me he was extremely anaemic and complained of having suffered from neuralgic pains over his left temple for about ten years. The nerve had been stretched about five years before I saw him and this had given him some temporary relief. When the pains re-appeared resection was advised, but he would not submit to

the operation. Treatment was begun by using the Galvanic current, applying the anode along the course of the nerve from the exit to its terminal distribution on the forehead, and also by giving him chalybeate tonics internally. Subsequently I applied the Faradic current by having him grasp the cathode while I held the anode in one hand and touched the affected parts with the fingers of the other. In connection with this, I used the static current, passing the sparks through the nerve by means of the Douchennes points. This method of treatment was continued daily for a month at the expiration of which he was almost entirely relieved of his pain. He went home and had no return of the trouble for about a year, when he took chills and fever following which the pains again appeared, though not as severe as before. He returned, put himself under another similar course of treatment, and in a few weeks was entirely relieved.

SCIATICA: Next to the trigeminal, the sciatic nerve and its branches are most frequently affected, and in fact prove more rebellious to treatment than any of the other forms, unless the exciting cause be discovered and removed prior to the institution of treatment of the disease per se.

The etiology may be traced either to peripheral or spinal origin; while the exciting causes are generally found to be either colds, malaria, anæmia, gleet, stricture, or rheumatism.

Various methods of treatment, both medical and surgical, have been employed, though none yield such happy results as those derived from the application of the different electrical currents. In this disease the static current, applied by means of the direct spark, usually proves of greatest benefit; but if the cause lies either in a poisoned or an impoverished condition of the blood, the cabinet vapor and electrical tub baths are indispensable auxiliaries in overcoming this condition.

CASE XVIII.—*Sciatica*: Male, aged thirty one years; on recovering from an attack of malarial fever of thirty days' duration, was taken with a severe attack of sciatica. His attending physician treated him for two months, using all kinds of drugs and every known method except electricity, but with no avail, and as he was gradually growing worse under the treatment, I was asked to see him in consultation. I found

him suffering with an intense pain in his back that extended over his right hip and down his leg as far as the knee.

I began treatment by making a stable application of the Galvanic current, placing the anode over the seat of the pain in his back, while the cathode was applied to his feet. After the third treatment he was able to rest comfortably in bed, and was also able to walk about the room for the first time in three months. He was brought to my office daily and the treatment pursued as before, but in addition the static current was also used. He continued to improve, and in two months was dismissed from my care entirely relieved.

About a year thereafter he began to feel a return of the pains, and as they gradually became severe, sought my advice. I applied the static current daily for a week, following which the pain disappeared, and he has had no return since then.

CASE XIX.—*Sciatica*: Male, twenty-eight years old: had been suffering with sciatica for a year and was under the treatment of different physicians for the greater part of that time, but had not been benefited by any. He concluded to try "electric baths" and came to my office for that purpose. After a week of daily baths he felt very much relieved. He continued for two weeks longer, and in connection with the electric baths the static current was used, but there followed no further improvement. Desiring to ascertain the cause of his trouble I made a thorough physical examination, and discovered a stricture, which on inquiry I found to be of two years' standing. I relieved the stricture by electrolysis, and at the same time continued treating the sciatica. In six weeks he was dismissed entirely cured.

CASE XX.—*Sciatica*: Similar to the foregoing case. For several years he had suffered with stricture of the urethra that was accompanied by almost constant pains over the region of his kidneys and down his limbs. Was unable to rest comfortably in any position.

The stricture was cured and the sciatic pains subsequently treated by electricity and in a short time he was entirely relieved.

CASE XXI.—*Sciatica*: Male, thirty-seven years of age; suffered with a very obstinate form of sciatica that yielded to treatment only after the use of the different currents applied in various ways, and then again returned after a month's discontinuance of the treatment.

The only exciting cause to which the trouble could be traced was mental taxation, for the pains would usually come on shortly after the first of the month when business cares kept him working harder than usual. A few treatments, however, generally relieved him for the time being.

CASE XXII.—*Sciatica*: Male, aged fifty; had received a blow upon his right side from which he suffered for several weeks when an eruption appeared along the course of the nerve and at the same time the sciatic pains became much more intense. He made all kinds of local applications but received no relief. He came to me for treatment and I applied the Faradic current at first, but subsequently, having diagnosed a neuritis, I used the Galvanic current with the anode over the painful parts. This was followed by relief in three weeks time.

CASE XXIII.—*Sciatica*: Female, thirty-three years of age; married and the mother of four children; had suffered with dysmenorrhoea and pain in her back for two years after the birth of her last child, and six months before consulting me was taken with sciatic pains in her left limb which were of so severe a type as to produce atrophy of the muscle and cause her to limp in walking. She had been under treatment in Hot Springs, Ark., and while there was greatly benefited, but the pains returned in all severity as soon as she had returned to her home.

Following the return of these pains she applied to me for treatment. After a thorough examination I employed the electric cabinet vapor bath by passing the Faradic current through the pelvis and limbs. Almost immediate relief followed, and the occurrence of her sickness was accompanied by no pain, as it had been hitherto. The muscles of the impaired limb also began to develop and in the course of three months she was entirely free from pain and could walk without the least sign of limping.

INTERCOSTAL NEURALGIA. Intercostal neuralgia is by no means an uncommon affliction, and at times gives the physician great trouble in its treatment. When due to malarial, neurotic, or traumatic causes it generally yields readily to electrical applications, but when brought on by caries, spondylitis or other diseases of the vertebrae, or tumors pressing upon the nerve or involving it there is seldom a cure established unless preceded by complete removal of the exciting cause.

In the treatment of intercostal neuralgia the Faradic current, ap-

plied by the several different methods, yields by far the best results.

CASE XXIV.—*Intercostal Neuralgia*: Male, forty years old; had been suffering with chills for some time when he developed a pain in his right side that came on every evening and lasted for several hours, the attacks generally being so severe as to keep him awake about half of the night. After he had been having the pains for several successive days he noticed the appearance of an eruption along the course of the nerve to which ointments were applied, but this only seemed to increase the trouble. As the attacks were gradually becoming severer in type he concluded to seek medical advice.

After investigating the trouble, I made an application of the Faradic current and told him to return for a similar treatment on the following day. I did not see him again for ten days, when on accidentally meeting him he told me that the eruption quickly disappeared, and, as he had felt so much better after the one treatment, he thought it unnecessary to have the application repeated.

DISEASES OF NERVES OF SPECIAL SENSE.

In the treatment of the various diseases taking their origin in the nerves of special sense the Galvanic current is used with greatest advantage, since here a view both to polar and direct effect upon the nerve or organ must be observed.

In treating the eye for glaucoma or any of the diseases affecting its interior, the current is applied by means of a special cup filled with water (Fig. 21) and so adjusted to the organ, that, by allowing an equal distribution of the conducting fluid over the entire external surface, the current is caused to flow with perfect uniformity, and at the same time is greatly modified in intensity.

In treatment of the ear for deafness, especially if the disease can be traced to perverted conditions of the Eustachian tube or middle ear, the best method of applying the current is by placing the anode to the meatus by means of a special electrode devised for the purpose (Fig. 21), and the cathode to the mouth of the Eustachian tube.

By applying the current in this manner in a case under my observation, the power of hearing was increased immediately thereafter from a distance of two to that of six inches. Subsequent treatments, however, were unable to effect further improvement.

DISEASES OF THE SKIN.

Diseases of the skin may either be treated by the direct or the indirect methods. The different currents are applied to the skin directly; for the purpose of counter-irritation, to act as a stimulant in anaesthesia, or a sedative in hyperaesthesia. As a counter-irritant or stimulant the direct and indirect spark of the static, the cathode of the Galvanic, or the secondary Faradic may be used in various strengths as indications require. As a sedative, the anode of the Galvanic yields best results. Frequently diseases of the skin are due to lesions in the trophic nerve centre, or the nerve centre that controls the nutrition of the skin, in which case the treatment must be referred to these parts. The following case reported by me in the *Alienist and Neurologist* of June 1886, and subsequently copied by *Les Progres Medicales* and other European journals will illustrate the importance of this fact.

CASE XXV.—*Disease of the Skin the Result of a Lesion of the Trophic Nerve Centre.* Miss C., aged 14; was sent to me by Julius Wise, M.D., of St. Louis, in March 1885. Her previous history was as follows: In 1878 she had some form of fever (probably yellow) on recovering from which all the hair over her body, even the eye brows and lashes, fell out. When I first saw her she had been in that condition for already seven years, though during that time had been taken to New York, Cincinnati, and St. Louis and treated by specialists of these places, yet with no sign of improvement. Family history revealed no scrofulous or syphilitic heritage. She was physically well developed and was in perfect health save the occurrence of frequent headaches.

On examination I found the skin dry, scaly, and atrophied all over her body, with the exception of her scalp, which was glossy. My first diagnosis being that of malnutrition of the skin due to some obscure cause, I began by giving arsenic and cod liver oil internally, and making various local applications of ointments. This method of treatment was continued for two months without any signs of improvement.

I finally concluded that the disease must be due to a lesion in the "trophic nerve centre," and thereupon, discontinuing internal treatment, resorted to the application of electricity exclusively, by administering general Faradisation and central Galvanization, and in

connection applied the Faradic current to the scalp by means of a sponge or brush electrode. At the end of the first month of treatment by this method the only changes observed were a more healthy appearance of the skin, and a less frequent recurrence of the headaches.

At the end of the second month's treatment her skin showed marked improvement, the headaches had entirely disappeared, and fine hair began to appear in patches on the right side of her head. After the third month the fine hair could be seen all over the right side up to the medium line, but the left was still entirely bare. At the end of the fourth month, however, it began to appear, while that on the right side had grown to a length of from a quarter to half an inch.

The treatment was continued for ten months followed by complete restoration of the hair all over her body and a perfectly natural appearance of her skin.

This case, with the addition of two others of very similar nature, one of which I still have under observation, appears to me to clearly demonstrate the existence of a "trophic nerve centre" and also that impaired conditions thereof can be successfully treated by the judicious use of electricity.

RHEUMATISM.

Rheumatism is a term, used both by members of the profession and by the laity, that includes under its heading a large number of ailments. Fothergill says: "Rheumatism covers an immense range of pains, extending from the lightening pains of locomotor ataxia to the periosteal affections caused by syphilis." The pathology is as yet clouded with doubtful speculations and theories; while some (Hunt, Todd, Richardson) hold that it is due to the accumulation in the body of the lactic acid resulting from the fermentation of glycogen; others (Constatt, Seitz,) claim that it is a neuroses brought on by a chill of the peripheral nerves, producing a perverted action of the corresponding nerve centres, which in time react upon the joints and other affected parts; while a third number of pathologists declare it due to poison of the nerve centres by lactic acid, the source of which they fail to trace.

Though free to admit the lactic acid theory, I am firmly of the

opinion that the disease is either a neurosis per se or intimately related thereto; for the reasons that the character of this disease simulates that of the neurotic type, and also that the effects of the different electric currents upon it are similar to those of other neuroses.

CASE XXVI.—*Rheumatism*: Female, aged forty five; kindly sent me by Dr. Heber Jones, of this city. She had been suffering with rheumatism for about a year, although under constant medical treatment, and lately there were developed several very painful rheumatic nodules.

She took the vapor baths with both Galvanic and Faradic current applications for three weeks before any marked improvement was manifested. By the end of the third month, however, the nodules had entirely disappeared and she was relieved of her suffering.

CASE XXVII.—*Rheumatism*: Male, thirty-six years of age; had suffered with rheumatism in all his joints at intervals for many years, and had been accustomed to go to Hot Springs for treatment at least once and sometimes twice a year.

In a month's treatment by means of the electric bath he was entirely relieved.

CASE XXVIII.—*Myalgia*: Dr. F., a prominent physician of this place, consulted me in regard to a severe attack of muscular rheumatism with which he was suffering. He had not been able to sleep for a week, and could not rest comfortably either sitting or lying down. Had taken quinine and other medicines but they gave him no relief.

I advised the application of the electric current, to which he objected, saying that electricity always had a very bad effect upon him. He was persuaded, however, on being assured that a very weak current should be used, and I applied the Galvanic current by placing the anode over the painful parts and allowing him to grasp the cathode with his hand. After continuing the application in this way for twenty minutes he was entirely relieved of his pain. I told him to come to my office again on the following day, as it would probably be necessary to keep up the treatment for some time. I did not, however, see him until a week after the application, when, on meeting me, he said that there had been no need of his return for treatment since the trouble had all disappeared.

CASE XXIX.—*Rheumatism*: Female, married; had a severe type of rheumatism in her shoulder and back. The static current was applied and relief followed after a week's treatment.

CASE XXX.—*Rheumatism*: Male; following a severe cold had rheumatism in his neck and shoulder. Was relieved by three applications of the static current.

CASE XXX.—*Rheumatism*: Male, thirty years of age; a resident of Nebraska, but had come to Hot Springs, Ark., for treatment, from which place he was sent to me by Dr. Dunn, of Greenville, Miss., who was visiting there at the time. Had suffered with articular rheumatism three months before leaving home. When he came to the Springs he was very much emaciated and unable to stand upon his feet. He remained there taking baths and medicine daily for three months, at the end of which time his general health was very much improved, but was still unable to walk without the aid of crutches, nor bear any weight upon his left leg. The knee was still swollen, the inflammation extending six or eight inches above and below the joint.

I applied both the Galvanic and Faradic currents daily. In the time of a week he was able to walk across the floor, and after applying the current for five weeks longer, the swelling entirely disappeared and he was able to walk without any difficulty. He left for home shortly afterward completely cured.

CASE XXXI. — *Rheumatic Gout*: Male, fifty years of age; had frequent acute attacks of rheumatic gout that generally lasted from one to two weeks, and on subsidence of the acute symptoms the affected joint would remain stiff and weak for several months. Following an acute attack of this kind he came to me to be treated for stiffness of his toes and ankles.

He was given an electric bath, and after ten days' treatment in this manner he was relieved.

A subsequent attack in the joints of his hands, occurring about three months thereafter, was relieved in a similiar manner. He was advised to continue the treatment for several months with a view of getting permanent relief, though he has never done so, and, as a consequence, still has occasional attacks.

EPILEPSY.

There is no malady in which the etiological factors are more diversified and, at times, more obscure than in epilepsy. While in some instances it makes its appearance in an unmistakable outbreak that can be referred to a definite cause, in others it comes on in so insidious a manner that at first even a diagnosis is baffled, and its causation wholly untraceable.

Its etiology may, however, be traced to either a direct or an indirect cause. If direct, it is due to an interference in the cerebral circulation brought about either by pressure of tumors, traumatism, or other causes producing the same effects. If indirect, it is due to reflex spinal irritation brought on by a disturbance of the sensory nerve terminals in any organ or tissue of the body, whence it is transmitted through the sensory tracks to the brain, where these spasmodic attacks take their origin.

The recurrence of epileptic seizures after the cause has been removed, as is so frequently the case in the type brought on by reflex irritation, is due to the fact that after several attacks molecular changes take place in the brain substance (without any perceptible organic lesion) which produce a habit or predisposition to fits

The extent of these molecular changes varies greatly in proportion to the length of time affected; and as the frequency of occurrence and length of continuation of the disease also depend upon the extent of these changes, relief in some cases speedily follows the removal of the exciting cause, if discovered, while in others, of longer standing a cure can only be effected after prolonged treatment; while in a third number, there may have been produced such indelible changes that treatment can prove to be no more at most than merely palliative.

CASE xxxii.—*Epilepsy Due to Preputial Irritation*: Boy, eleven years old, and delicate in appearance. Suffered with indigestion; was troubled with excessive and frequent micturitions, and had from one to five epileptic attacks daily. Was confined to his bed most of the time. He had been taking large doses of potassium bromide for several months, and when he first began taking the medicine was somewhat benefited, though it soon lost its effects.

On making a thorough physical examination I discovered adhesions of the prepuce and a very irritable glans. Circumcision was per-

formed at once, the parts healing without any trouble. I then gave him sodium bromide internally, and after he was able to come to my office I made daily applications of central Galvanization and general Faradisation.

The result in this case was unusual, since he never thereafter had another epileptic convulsion. I employed him as office boy and kept him under close observation for two years, at the expiration of which time he had grown stout and healthy.

CASE XXXIII.—*Epilepsy Due to Nervous Dyspepsia*: Male, eighteen years of age; had been suffering with epileptic convulsions for three years. When the disease first appeared he was treated with potassium bromide which lessened the number of attacks at first, after which, however, they became more frequent.

After a thorough examination I diagnosed nervous dyspepsia as the exciting cause.

As potassium bromide is more irritating to the stomach than is sodium bromide I substituted the latter as internal treatment, and also applied the Galvanic and Faradic currents to his spine and stomach. This soon relieved the nervous dyspepsia. I kept him under treatment for more than a month, after which he was sent home with instructions to continue the use of the sodium bromide for at least six months. Nine months afterward, I received a letter from him saying that he had discontinued the use of the medicine, as he had suffered no recurrence of the attacks since he left my infirmary.

CASE XXXIV.—*Epilepsy of Obscure Causation*: Boy, nine years old; had always been very delicate in health. At the age of three he began with paroxysms of the "petit mal," and at the same time suffered with impairment of his right arm and leg. He had been examined and treated by a number of physicians, all of whom prescribed either potassium or sodium bromide, but despite all treatment he grew worse and the paroxysms became more frequent.

On the 15th of April, 1889, his father brought him to me for examination. I found a very long, though not adherent prepuce covering an extremely irritable glans and concluded that he would be greatly benefited, if not entirely cured, by circumcision. The operation was subsequently performed, and on May 15, the parts having healed, elec-

trical treatment was begun. I first applied central Galvanization in conjunction with general Faradisation and continued it by daily treatments for a month. At the expiration of that time there was no perceptible improvement, and he was still having from five to ten paroxysms a day. After being under treatment for six weeks, however, there were marked signs of improvement; so much so, that at times there would be an interval of ten days between the paroxysms. This continued for two months when he began having chills and fever, following which the attacks came on again as frequently as before, and when treatment was discontinued, November 1, the recurrences again became as frequent as when I first saw him.

The complete failure in the relief of this case I think was at least partly due to the intercurrent of malarial attacks; though it may have been due in part also to the long standing of the disease, or possibly to a complication of causes that were never discovered.

CHOREA.

The symptoms of chorea are generally so well defined as to render the diagnosis in most cases very easy. It is a disease essentially belonging to childhood, and occurs about the age of puberty in either sex, though preferably in the female.

The disease is that of a neurosis and, like all others of its kind, is more frequently found in families where nervous diseases are hereditary.

It is especially amenable to treatment by means of electrical applications, and as a rule yields readily in one or two months to a tonic course of general Faradisation.

CASE XXXV.—*Chorea*: Girl eleven years of age; while at school was taken with twitchings of the muscles of her feet, which soon extended up her limbs, and subsequently appeared in her hands and arms. She also became exceedingly irritable at the time of the attack, an occurrence that was in direct opposition to her usual temperament.

She was kept from school and treated for two months with the usual remedies prescribed by the family physician, but her condition remained unaltered. Following this she was sent to me for electrical treatment. I treated her by means of the electric cabinet vapor and

tub baths used conjointly, and in four weeks dismissed her entirely cured.

CASE XXXVII.—*Chorea*: Girl thirteen years old; of a very nervous temperament, inherited from her mother; had suffered with an obstinate attack of chorea for already six months, at times becoming better, then again growing much worse. The family physician diagnosed suppression of menses and prescribed chalybeate tonics and hot hip baths, but no relief followed the treatment.

On being referred to me, I gave her the electric cabinet baths, passing the current directly through the womb as well as through the entire body. As the result of a month's treatment her menses appeared at proper time, after which rapid improvement followed and by the end of the second month she was cured.

CASE XXXVII.—*Chorea*: Boy nine years old; had been suffering with chorea a month when he fell into my hand. I gave him electric tub baths and in two months time he was relieved from all symptoms of the disease.

DISEASES OF THE STOMACH.

Owing to the intricate and extensive nerve supply, and also from the fact of its great exposure to functional disturbances by the ingestion of either too large quantities, or improper kinds of nourishment, the stomach is one of the most frequently affected organs of the body.

Diseases of the stomach may be due to either inflammatory, structural, or functional disturbances; the former manifesting themselves in the various forms of gastritis; the structural in degeneration, dilatation, carcinoma and ulcers; while the functional, relating mostly to the impairment of digestion appear in acute dyspepsia, indigestion, and gastralgia.

Of all these different diseases those most amenable to electrical treatment, and from which most favorable results may be expected, are the ones due to functional disturbance of the organ, though many belonging to the other forms may be treated with equal success by judicious selection and application of currents.

Dyspepsia is a term generally applied to all functional disorder of

the organ in which there is disturbance of the digestive processes in different ways, as well as, where the digestive performance per se appears only to be difficult; so that, for the sake of describing the cases more clearly, I shall call that form due to disturbance of the digestive processes indigestion, while that, where there is only difficulty of the performance of the act of digestion, shall be comprised under the head of atonic dyspepsia.

CASE XXXIII.—*Indigestion*: Lawyer thirty-five years of age; had suffered from indigestion for ten years, and was gradually becoming worse from year to year. He had taken tonic remedies of all kinds, but they improved his condition only temporarily; and after taking them for awhile they lost their effects and left him no better. He suffered very little pain at any time, but after meals there would be a disturbance of the stomach, lasting for several hours after the ingesta of food, that gave him considerable inconvenience, since it caused him to feel dull and stupid, and wholly unfit for work. After a number of eructations of gas, he would generally be relieved for the time being. The tongue was broad, flabby, and slightly coated, but not red as in gastritis. His bowels were constipated, and the stools often contained particles of undigested food. He suffered with palpitation of the heart that was aggravated after a full meal. He was also very restless at nights, especially if he had partaken of a hearty supper.

I began treatment by applying the Faradic current over the stomach and bowels daily for about a week, at the same time prescribing one of the bitter tonics, and cascara sagrada in sufficient doses to regulate his bowels. By the end of the week he was somewhat relieved, and as improvement continued, the doses of medicine he was taking internally were gradually diminished, and at the end of a month's treatment entirely discontinued. The application of the electric current which hitherto had been made daily, was now made on alternate days, and later but twice a week.

At the end of three months he was entirely relieved of his trouble, and was able to take all kinds of food and suffer no subsequent discomfort.

CASE XXXVII.—*Atonic Dyspepsia*: Male, 45 years old, and of sedentary habits; had suffered with dyspepsia for several years. The

attacks would come on more or less acutely and last about ten days. During this time he would suffer severe pains in the region of his stomach while digestion was going on; following which, he would feel very much depressed and be extremely nervous and restless at night. After these acute attacks had passed off there would be intervals of a week or two during which time he would have comparatively little trouble, until all of a sudden there would be a recurrence of the prior symptoms.

On coming to me for treatment, I applied the Faradic current by means of the electric tub bath daily for about four months. Following this he suffered no more acute attacks, and felt no inconvenience from his digestive organs, unless at times when he was incautious as to the eating of foods difficult of digestion.

CASE XXXVIII.—*Atonic Dyspepsia*: Female, forty five years of age; had suffered for five years almost incessantly. The disease had produced palpitation of the heart that gave her very much trouble shortly after taking food, when her stomach became distended with gas. The attacks were so severe in type during some nights as to necessitate her sitting up in bed in order to breathe.

I prescribed a bitter tonic and gave her daily treatment by means of a general application of the Faradic current. In four weeks she had recovered completely, and has not been troubled with disorders of her stomach since.

FUNCTIONAL DISEASE OF THE INTESTINES.

The intestines are subject to diseases produced by the same cause as those of the stomach, and the functions of the two are so intimately associated that disturbance of one is very liable to produce a corresponding perverted condition in the other. Hence, when the stomach fails to perform its part in the process of digestion, the food passes into the bowels in an improper state of preparation; fermentation takes place, forming gases and other irritating compounds that interfere with the intestinal digestion, impair the peristaltic action, and as a result the disturbance manifests itself in the various maladies producing either a diarrhoea or extremely constipated condition, as the case may be.

The disease may, however, originate in the bowels alone, or even portions thereof, where from some cause the peristaltic action of that part of the intestine has been impaired and particles of food that have lodged there act as foreign bodies, set up an inflammation, and subsequently produce an ulcerous condition from which may result a chronic diarrhoea, or even give rise to more serious troubles; or should there be no inflammation it may produce a relaxed, atonic state of the intestines impairing peristalsis, and hence result in obstinate constipation.

These various conditions yield by far more quickly and more effectively to electrical treatment than any of the medicinal methods usually employed. Especially is this the case in obstinate constipation where the continual use of cathartics, instead of effecting a permanent cure, merely affords temporary relief, and besides, places the patient into such a condition that if the drug be not employed continually and in gradually increased doses, not only will there be afforded no permanent relief, but, by reason of the body adapting itself to the presence of the cathartic, there is demanded its co-operation to the performance of a mere natural function; and not only this, but in order to excite the bowels to action, there is required a dose the size of which, necessary to be of any avail, is certain to leave its injurious effects upon the other parts of the economy.

CASE XXXIX.—*Chronic Constipation*: Male, forty-five years old; had suffered with obstinate constipation for fifteen years. In this time he had taken all kinds of purgatives, increasing the dose of each as its effects wore off, but his condition gradually became so bad that his bowels could only be moved by very large doses of the most powerful medicinal agents.

On applying to me for treatment, I began by using the secondary Faradic current with the large roller electrode over the bowels, and the cathodal sponge on the spine. This was continued daily for a week, at the end of which it was found that he could get the same cathartic effect from half the quantity of purgatives he had used before this method of treatment was instituted. The applications were continued for a month, and as a result he had been relieved to such a degree that he would have daily actions without taking medicine for a week or more, and then only very moderate doses were necessary.

CASE XL. — *Chronic Constipation*: Female, thirty years of age, and married. Had suffered with chronic constipation for twelve years. Was troubled with a constant pain in her back, frequent headaches, and irregular menses. When she came to me for treatment she weighed but ninety pounds

She was treated with the electric cabinet vapor bath, in which the Faradic current was passed through her back and abdomen. In connection with this, manual and electro-massage was also employed. The saline cathartics and purgative pills that she had been using were discontinued, and instead the fluid extract of cascara sagrada was prescribed, at first in moderate doses, which, in connection with the electrical treatment, proved sufficient. Subsequently, as improvement progressed, the dose of this was also diminished, until after three months' treatment she was able to have natural evacuations without the use of any medicine.

The treatment was given daily for three months, and on alternate days for two months longer. When dismissed she weighed one hundred and twenty-five pounds, was free from headaches, and had perfectly normal evacuations daily.

I have treated a number of cases similar to this with equally good results where the treatment was continued sufficiently long to enable the bowels to be restored to their normal condition, and I think failure to obtain good results in the majority of these cases is due more to the fact that treatment is not continued long enough, than to the inefficacy of the remedy.

CASE XLI. — *Stricture of the Rectum and Constipation*: Male, twenty-seven years of age; sent to me from Arkansas. At the time he came to me he was very anæmic, had a poor appetite, was extremely nervous and despondent, suffered with sleeplessness every night, and besides was habitually constipated.

On examination I found a stricture of the rectum about an inch above the internal sphincter, that was exceedingly sensitive and contracted firmly upon my finger on attempting to pass it. I introduced a small electrode and applied the Faradic current with a view of obtaining its tonic effects upon the bowel, and thereby relieve the stricture; but, contrary to my expectation, it became much more rigid and sensi-

ative. I then applied the cathode of the Galvanic current, and in conjunction employed general Faradisation and electro massage over the abdomen.

Improvement followed after the first month; and in two months he was able to sleep well, his bowels moved regularly, and the stricture had entirely disappeared.

A few weeks prior to the appearance of any marked improvement in this patient, another case of very similar nature was brought to me for treatment; but, as I regarded the recovery of the one I was having under treatment as being very uncertain, I declined taking charge of the case, and dismissed it with an unfavorable prognosis.

CASE XLII.—*Impaction of Faeces*: Female, aged forty. Had been in good health up to the time of the attack. This came on suddenly in the form of an obstinate constipation with tympanitis and colicky pains. Purgatives of calomel, aloes, and salts were given for three days without any evacuations resulting. Opiates were then given with a view of relaxing the spasmodic condition of the bowels, but they also failed. Subsequently, the Faradic current was applied to the abdomen as strong as it could be borne without causing pain. This was continued for twenty minutes but no impression was made. On the following day the current was applied by means of a rectal electrode that was introduced well into the bowel. This produced a copious discharge of hardened feces, following which the patient was relieved.

In the treatment of diarrhoea by electrical applications the desired results may be obtained either directly or indirectly. In the former by its action upon the intestine itself, by stimulating intestinal digestion and regulating peristalsis in cases where there is impairment of these functions; and in the latter by its actions upon the organs producing this disturbance and thus, by improving their condition, correct the disorder.

CASE XLIII.—*Diarrhoea*: Male, forty years of age. Had been suffering with looseness of bowels and flatulence for eighteen months during which time he had been reduced from 180 to 120 pounds. Everything eaten disagreed with him, and he was so weak that he became

thoroughly exhausted on walking a distance of but two blocks. When he came under my observation he was taking whisky to strengthen him and aid his digestion. This was discontinued and instead I prescribed digestive preparations.

On physical examination I discovered ulcerations of the rectum, and furthermore found that there was impairment of motion on his right side, and that he suffered pain in his back with sensations of weight about his feet.

The ulcers of the rectum were treated locally and in connection therewith I passed the Faradic current through his back and abdomen. In the course of three weeks there were evidences of marked improvement to be seen. By the end of six weeks' treatment the diarrhoea had ceased, he had gained twenty pounds, and was able to walk a mile with but little fatigue following the exertion.

About this time a friend persuaded him to think that he had some trouble with his liver and sent him to his family physician for treatment. The physician concluding that it was some form of liver disorder, prescribed cholagogue preparations which produced vomiting and purging and so depressed him that he never rallied therefrom.

CASE XLIV. — *Chronic Diarrhoea of Four Years Standing:* Female, twenty eight years of age, and married. She was very much emaciated when I first saw her and weighed but ninety pounds. She was then having from three to eight evacuations a day though unaccompanied by pain. Had been treated by different physicians at various intervals but obtained only slight temporary relief.

On physical examination I found a very relaxed condition of the mucus membrane of the rectum, but no signs of ulcerations as I had expected.

She was thereupon given in charge of my masseur who was instructed to use general massage with electro-massage over the abdomen daily.

After she had been under treatment for a short time she began to improve in weight, gained strength, her complexion assumed a more healthy appearance, and her bowels moved less frequently day after day until, after a few months treatment, she was entirely relieved.

DISEASES OF THE LIVER

By reason of the extensive part that the liver plays in the maintenance of the animal economy by its three-fold function, the proper treatment of its necessarily numerous and varied derangements becomes a matter of great importance. Electricity yields happy results both in the functional disorders and also in affections of the individual structures of the organ per se. In impairment of the secretory function, either in a hypersecretion or an insufficient production of bile, we may apply the current with a view of correcting the perverted condition by means of its stimulating influence; in impairment of the excretory function, when the nerve waste or cholesterine is not sufficiently removed from the blood, we may expect good results from the tonic effects of the current; and in impairment of the glycogenic function, where there is lack of tone within the lobules, due to a torpid condition of the organ, a stimulating current is of great benefit. On the other hand, in a hyperaemic or congested state of affairs, due either to malarial or other toxic influences producing blood stasis within the extensive capillary systems of the organ, relief may again be advantageously sought in the application of electrical currents.

CASE XLV.—*Torpidity of Liver:* Male, forty years old. Suffered with dull headache continually. Was extremely costive, the stools being of a white, ashy color.

On taking mercurial cathartics he would generally be relieved of the symptoms and feel better for a few days, following which there would again be a return of the trouble. After continuing in this way for some time he was induced to try the applications of electricity by means of the cabinet bath. The Faradic current was passed through the liver and bowels daily for several weeks, at the end of which time the headaches had entirely disappeared, the evacuations were natural and he suffered no further trouble.

CASE XLVI.—*Jaundice:* Male, twenty-eight years of age; had been troubled with frequent attacks of jaundice, each of which usually continued persistently from two to four weeks. I first treated him with large doses of purgatives, followed by dilute hydrochloric acid. This generally relieved him for the time being, but made no permanent impression upon the morbid condition. On July 10, 1889, he

came to my office while he was having another of these attacks. On physical examination I found the gall bladder very perceptibly distended. I attempted to empty some of its contents by pressure, but was unsuccessful. I then applied as strong a Faradic current as he could bear directly over the engorged sack and pressed the sponge electrode firmly upon it. In a few moments he experienced a desire to go to stool, and on examining the evacuations they were found to contain copious billious discharges. He was subsequently treated by means of the electric cabinet vapor and tub bath, and has not been afflicted since.

CASE XLVII. *Enlargement of the Liver and Spleen, of Malarial Origin:* Female forty-six years of age; had suffered with malarial attacks for several years. On January 5, 1885, I was called to see her and found her suffering with intermittent fever accompanied by haematuria. The liver and spleen were both very much enlarged, and on inquiry I found that they had been in this condition about a year despite all medical remedies employed. After recovering from the acute attack of fever I began treating the enlarged organ by giving digitalis and iodine internally, and by applying the Faradic current to the abdomen.

This treatment was given daily for the first month and was followed by marked improvement in general health, and considerable reduction in size of the liver and spleen. The current was then applied in the same way on alternate days, and in two months they were reduced to their normal size.

CASE XLVIII. *Congestion and Enlargement of the Liver from Malaria:* Male, eleven years of age; pale, anaemic, and had been suffering with chills and fever for two months. His home was in low, marshy lands where these afflictions are quite common. He was brought to me on November 5, 1885, in a very weak condition, and having a constant diarrhoea. On physical examination I found the liver very much enlarged, and the spleen in a similar state. He measured thirty-one inches around the waist.

I gave him as internal treatment, iodine, alternating with arsenic, and in addition quinine and strychnine for a month, but little relief followed. I then resorted to daily applications of the secondary Faradic

current over the liver, spleen and spine. By January 1st the organs were very much reduced, the waist measure being twenty-eight inches. His bowels were regular, appetite good, and he was greatly improved in every way. By the end of February he had entirely recovered.

CASE XLIX.—*Congestion and Enlargement of the Liver Due to Malaria.* Male, thirteen years old; had been having paroxysms of intermittent fever for several weeks. Subsequently he suffered an attack of pernicious intermittent fever that confined him to bed for some time. On recovering from this his liver and spleen became very much enlarged, and was followed by indigestion and diarrhoea.

I applied the Faradic current to the enlarged liver and spleen, and in a short time there followed reduction of the organs to almost normal size, and complete restoration of his general health.

FUNCTIONAL DISEASES OF WOMEN.

The recent progress in the electrical treatment of both functional and organic diseases of the uterus and its appendages, has marked a new era in this important branch of medicine. The relief afforded by this mode of treatment in the numerous different disorders, all of which have as their most prominent symptoms pain in the back radiating down the limbs, headaches, languid feelings and depressed spirits, frequently far exceeds the physician's most sanguine expectations; and especially so after treatment by all other means has failed to be of any avail.

AMENORRHOEA.

In suppression of menses either at the age of puberty, or supervening at a later period from various exciting causes, the electric current, when properly applied, is the most certain and harmless emenagogue we possess.

In young girls, where there are indications of an undeveloped uterus or ovaries, the primary Faradic passed directly through the organ by placing one of the electrodes over the abdomen and the other over the spine yields better results than any of the other currents. In fact, the result in the treatment of such cases in my experience has been so uniformly good that I regard it as being almost a specific.

CASE I.—*Amenorrhoea*: Aged twenty-one, single. Applied for treatment April 4, 1884. Was very delicate and anaemic. Suffered constant pain in her back and head; would tire on the slightest exertion. She had menstruated but twice in her life, and then it had been brought on by medicines that had each time confined her to bed for several weeks. Since the age of puberty she had been taking tonics of iron, nux vomica, and other bitters constantly without any relief.

Electrical treatment was given by means of the cabinet bath apparatus in which the current was passed directly through the uterus; and in conjunction general Faradisation was used with a view of obtaining its tonic effects upon her general system. These applications were made daily for two weeks, when her menses appeared in a scanty flow that continued for a day only and were unaccompanied by any pain whatever. After having discontinued treatment for three days it was again resumed. Twenty-five days thereafter, or twenty nine days from its first occurrence her catamenia reappeared, the flux continuing for three days. By this time she had gained ten pounds in weight, the pains in her back and head had disappeared, and she was in good general health. She left the city after discontinuing treatment and I did not see her again until a year thereafter, when she informed me that thus far she had not missed a single epoch.

CASE II.—*Amenorrhoea*: Was brought to me by her mother, who gave the following history: She had been perfectly healthy up to her twelfth year when she began suffering with pains in her back, head, and eyes. The pain in her eyes became so intense that she was compelled to leave school. Her family physician treated her with tonics of iron and quinine, which gave her no relief from her troubles; but two months after the commencement of this treatment her menses appeared. For several days prior to their appearance, and during the whole continuation of the flow, her sufferings were so severe that she was compelled to remain in bed and resort to the use of anodynes for relief. Her catamenia did not again return, but two months afterwards there appeared a vicarious subcutaneous hemorrhagic condition of her face that extended from below both eyes across her nose. She subsequently became unconscious and remained so for two days. On recovering there was exfoliation of the skin in the locality of the

effusion. This disappeared in about ten days. When brought to me she had been suffering in this way for two years.

She was treated in the same way as was the preceding case except that I used in addition central Galvanization. After the tenth bath while preparing for another treatment her menses appeared, and without the least pain—the first time they had ever come on without three or four days suffering that necessitated her going to bed. Improvement progressed steadily from that time on, and after another month's treatment her sickness again appeared, painless as before, and her eyes, head, and back troubles were greatly relieved.

She was compelled to leave the city and treatment was discontinued. I did not see her again until two months after she had left when she was again brought to me. Her mother, thinking she had sufficiently recovered, returned her to school, whereupon her eyes began to trouble her again. She then recommenced electrical treatment and perfect recovery soon followed.

CASE LII.—*Dysmenorrhoea*: Thirty-three years of age. married. Had a child when twenty-one years old, and suffered with painful menstruation ever since. Was treated for inflammation of the womb about five years before and obtained some temporary relief, but in a few months had become as bad as ever.

She came to me for electrical treatment for the pain in her back and bladder trouble, but refused local treatment and declined to submit to an examination.

I recommended her to take the cabinet bath, and told my masseur to pass the current directly through the uterus. This was continued daily for three weeks, when her menses appeared, and to her great astonishment, without the least pain and three days before the regular time.

The treatment was pursued for three months, at the end of which time she suffered no more trouble.

CASE LIIL.—*Dysmenorrhoea*: Aged twenty-five, married. Applied for treatment in September, 1885. About two years before she had a miscarriage, which was followed by endo-cervicitis. She said she was treated and relieved of this, but her sicknesses had never been regular

thereafter. Three, four or five months would frequently pass by without the least sign of menstruation, and when it did appear the pain that she was constantly suffering in her back and limbs became very much worse and the dysmenorrhoea was intense.

In treating her both the Galvanic and Faradic currents were used by means of the cabinet bath, and applied in the usual manner. After the third bath her catamenia appeared at the proper time, and without the least pain. She took the treatment a week longer, then stopped. I did not hear of her for two months, when a friend of her's came to me for treatment, saying that she was suffering with troubles similar to those of Mrs —, who said she had been entirely relieved by the treatment.

CASE LIV.—*Dysmenorrhoea*: Mrs. W, twenty-four years old; married for six years; had no children. At the time of each menstrual epoch, she suffered intensely, with the usual pain in her back and head, and also irritability of her bladder. She had been under the care of a gynaecologist for about nine months, but obtained very little relief. When she went under his treatment he diagnosed inflammation of the neck of the womb with ante-version, and told her that there could be no cure effected unless by the constant use of a pessary. She tried to wear it for awhile, but it caused so much pain and irritation of the bladder that she was compelled to remove it.

On examination I found hyperplasia of the neck and ante-version of the organ. I reduced the cervix to its normal size by electrolysis, and subsequently applied the Faradic current ten minutes each time by means of a uterine electrode introduced well into the cavity of the organ. This was done three times a week, and by the end of the second week the womb remained in its normal position, and the irritability of the bladder had greatly diminished. Following this, the Faradic current was then passed through the abdomen and back by means of the cabinet bath, and by the expiration of a three month's treatment she had entirely recovered

TONSILLITIS.

Electricity is frequently of great service in the treatment of either acute or chronic inflammations of the tonsils. In

hypertrophied conditions especially, where the enlargement of the gland has existed for a considerable length of time, by daily applications I have frequently been able to reduce the tonsil to almost its normal size. Here the secondary Faradic current is of most value and may be applied either by placing the sponge electrodes over the glands externally, or, when this produces too much irritation, by allowing the patient to grasp one electrode while the operator holds the other and with the fingers of his disengaged hand presses lightly over the tonsil from without.

CASE LV.—*Tonsillitis*: Male, twenty-eight years of age; had suffered with hypertrophied tonsils for three years. Every few weeks he would have paroxysms of acute inflammations which usually gave him annoyance, and at times even confined him to his room. I treated him with local applications of astringents at intervals for two years with no more than temporary results. I finally concluded to try electricity and did so by applying the secondary Faradic current daily for fifteen minutes at a time.

After a month's treatment his tonsils were reduced to almost their normal size and the acute attacks of tonsillitis did not again appear

DISEASES OF JOINTS.

In inflammation of joints due either to sprain upon the ligaments or tendons, or traumatic influences, there is no other treatment that will yield such speedy and entire relief to these painful affections as the use of electricity. In many instances but a single application will suffice to cause the disappearance of all painful symptoms within a few hours after its use. It is of greatest benefit when passed through water. The disabled joint should be immersed into warm water contained within a non-conducting vessel (of porcelain or wood) and the poles of the battery placed on either side of it. The secondary Faradic current should be used, as it is by far more penetrating. It should be applied as strong as can well be borne without pain, and the application should be continued for at least half an hour.

As an after treatment following the breaking up of an ankylosis

where there is inflammation accompanied by severe pain, the application of a mild Faradic current will be found of great benefit.

CASE LVI.—*Sprained Ankle*: Miss N. sprained her ankle in May-1886. It remained swollen for several months after which the inflammation gradually subsided; but the joint remained very sensitive and the slightest mis-step would produce pains that were felt for several days afterward. In the latter part of the summer she again sprained it while alighting from a carriage. It became very painful and swollen, and after several weeks' treatment was put into plaster, and kept for six months. There was slight improvement in response to this treatment, but when the plaster was removed the joint was found to be still very much swollen and extremely tender.

The current was applied on alternate days for two weeks, followed by entire subsidence of swelling and relief of pain.

CASE LVII.—*Sprained Ankle*: Male, aged thirty. On October 10, 1889, he came limping into my office by aid of a cane. He sprained his ankle several days before, and had been using various domestic remedies, but derived no benefit from them. Prior to this time he had sprained the same ankle several times and ever since the first injury it would become swollen and painful on the slightest provocation.

I placed the limb into a large porcelain basin filled with warm water, and placed the poles of the battery on either side of the limb and six inches from it. The secondary Faradic current was applied as strong as could well be born for half an hour. I then advised him to return home and go to bed. I had no report of the result of this treatment until two days afterward, when I saw him dancing at a ball. On inquiry I found that he had rested very well the night after the application, and had no further trouble.

OPIUM POISONING.

As a means for maintaining artificial respiration in cases of opium poisoning, the use of the electric current is indispensable, and in many instances proves to be the only available method by which the life of the patient may be saved. Even after emetics, given either by the mouth or hypodermically, had failed to

produce any effect, I have frequently been able, by a long continued use of the current, to keep up a sufficient number of respirations to bridge the patient safely over the poisonous effects of the narcotic.

The method of treating a case of opium poisoning usually employed by me is as follows: If called to see the patient within half-an-hour after the toxic dose has been taken, in order to control all the symptoms that may arise, it is seldom necessary to do more than produce evacuations of the stomach by hypodermic injections of apomorphine, and counteract the effect of that already absorbed by hypodermic injections of atropine, taking the pupil as the criterion by which to gauge the dose. If, however the absorption of the drug has been more rapid, or if called a longer time after it has been taken, and the number of respirations have been reduced, as is often the case, to four or five per minute, besides the injection of atrophine and alcoholic stimulants, I also use the Faradic current to hasten the number of respirations.

In applying it one pole is placed over the nape of the neck, or along the upper part of the spine, while the other is placed over the diaphragm, preferably on the right side, so as not to approximate the heart. A Faradic current sufficiently strong to produce forcible contractions of the diaphragm is then passed, and by alternately closing and breaking the circuit with the electrode over the muscle, artificial respirations may be maintained for a considerable length of time. This should be continued at least until the number of respirations are no less than fourteen per minute.

CASE LVIII.—*Opium Poisoning*: About five o'clock of an afternoon, by mistake took sixteen grains of Morphine. Two of the nearest physicians were summoned and arrived about an hour after the drug had been taken. Various efforts to evacuate the stomach were made, but by that time he had become so thoroughly narcotized that all attempts to this effect proved of no avail. Hypodermic injections of atropine were administered freely and artificial inspiration kept up uninterruptedly. At ten o'clock they sent for me. As the message did not reach me until an hour later, before going, I inquired by telephone whether I was still wanted. One of the attending physicians answered that it would hardly be necessary for me to come, as he thought the patient would be dead before I could reach the place.

I, however, concluded to go, and taking a portable Faradic battery and suitable electrodes, drove out as rapidly as I could. On arriving I found the patient cold and breathing but five times a minute, despite all efforts at artificial respiration that could be made.

I immediately placed a large sponge electrode between the shoulders and another over the diaphragm in using a current sufficiently strong to contract the muscle forcibly. The electrode over the diaphragm was occasionally also placed over the pneumogastric the neck with a view of stimulating the nerve terminals in the heart and lungs in addition to exciting respirations. The number of respirations were at once increased to ten per minute and the action of the heart became improved. As soon however as the use of the current was discontinued the number of respirations became again as few as four and five per minute. I remained an hour and in that time kept the respirations up to ten and twelve continually. Before leaving I instructed the attending physician how to manipulate the battery and advised him to continue its use until the patient would have thirteen or fourteen respirations per minute without the aid of electrical stimulation. The current was used until ten o'clock the following day before it could be discontinued without a decrease in the number of respirations.

No ill effects followed the long continuation of so strong a current save a slight soreness that was felt in the region of the diaphragm for several days afterward.

DISEASES OF THE BLADDER AND KIDNEYS.

In all subacute and chronic inflammations of the bladder due in the male either to prostatitis, stricture, excess of uric acid or other similar affections, and in the female generally to uterine disturbances, in all of which the frequent voiding of urine, accompanied by pain is a prominent symptom, electricity will be found of great value.

It may be employed either by an external application of the electrodes over the region of the bladder and painful parts or, as is frequently of greater advantage, by means of a urethral electrode introduced well into the cavity of the viscus.

When, by reflex irritation, pain in the back is a prominent symptom this per se frequently yields to the static current when either of the others produces no effects.

In inflammatory conditions of the kidneys where no organic disease is present, the use of the Farradic current applied by means of the clay electrodes is frequently of great service in allaying these conditions.



PART IV.—ELECTRO-SURGERY.

The surgical uses of electricity may be embraced under the two distinct subjects. *electrolysis* and *electro-cautery*, both of which have in view the same end, though the means by which this is accomplished are vastly different. While in the former the chemical effects of the Galvanic current are taken into consideration and wholly depended upon for the change that is to be effected, in the latter the thermal effects of the current is all that is necessary, and its strength need only be regulated to accommodate the intensity of heat desired in the manipulation of the cautery blade.

ELECTROLYSIS.

Electrolysis is the process of producing chemical decomposition, and disorganization of tissue by means of the Galvanic current. In all compound fluids dissolution, either slight or to a marked degree, is constantly taking place by reason of the breaking up of the molecules composing the fluids into their primal atoms. Under normal circumstances nature provides for this disintegration by its various repairing processes, and no perceptible changes are effected. Experiments demonstrate, however, that by the aid of the electrical current in certain strength, this normal decomposition can be promulgated to such a degree that nature will be able no longer to counterbalance the overdrain by her recuperative powers, and hence there will be a loss of compounds, and subsequently of constituents, in the parts where the greater amount of dissolution is made to take place.

Only certain compounds are capable of disintegration by means of the Galvanic current. These are known as electrolytes. As however electrolytes form the chief constituents of the body, electrolysis

is possible in any of its tissues. The products of this decomposition are called ions – those collecting at the anode, anions, and those at the cathode, cations. Frequently the actual ions are not given off as such, but instead different chemical substances are found, and the disorganization promoted by the chemical changes thus effected. As a rule however, the ions proper to each pole may be distinctly recognized. In inorganic substances this may be easily demonstrated by passing the current through sodium chloride, in which case chlorine, the anion, will appear in bubbles at the positive, while sodium, the cation, will collect at the negative pole. Similar changes may also be produced in organic substances by passing the current through a piece of meat, where firm albuminous coagula will form at the positive pole, while gasses will be seen to escape at the negative.

This property of the electrical current is of advantage to the surgeon, either in the removal of morbid growths, or in effecting therapeutical changes in such parts of the body or under such circumstances especially where surgical procedure by any other means would be injudicious and at the same time attended with no little amount of risk on the part of the operator.

POLAR EFFECTS.

If an ordinary steel needle be attached to each pole of the battery, and with a current adapted for electrolysis an experiment be made upon a piece of meat, it will be noticed that the products accumulating around either one of the poles will be entirely different from those surrounding the other; that while the one needle is readily withdrawn, and is entirely unaffected, the other will stick with great firmness, and after being removed will show effects of having been subjected to some chemical change. If now the two parts from which the needles were withdrawn be subjected to microscopical examination, it will be seen that the part from which the unaffected needle was taken, shows evidence of molecular changes, and suggests the fact that some disorganizing process has lessened the normal compactness of its tissue; while in the other in which the needle was acted upon, it will be found that there is an increase of material surrounding the pole, due to the coagulation of the albuminous constituents, and

that in consequence the tissue is by far more compact than normally. On testing the chemical reaction of each of those products, those of the coagulated tissue will be found to be acid while the others are alkaline. These different phenomena are invariably proper to their distinctive poles, and if the needles are left intact and the poles reversed, their action upon the tissues of the meat will also be reversed.

This experiment demonstrates two distinct effects of the current, each of which may be taken advantage of, independent of the other, by the use of electrodes specially adapted to this end; and from it we may also deduce the following important principles of electrolysis as a guide to the use of the proper pole.

The positive pole coagulates albumen, causes fibrinous deposits, and draws to itself electro-negative elements, such as acids, oxygen, chlorine, etc.

The negative pole, in drawing to itself alkalies or bases, collects atoms that have no tendency toward combination, but, by being absorbed and carried away by means of the circulation, lessen the amount of tissue within electrolytic reach.

Therefore, where it is desired to produce deposits of coagula, as in aneurism, varicose veins, or hernia, the active electrode is attached to the positive pole; in those cases where the disintegration of tissue is the object in view, the active electrode is attached to the negative pole, except in hemorrhagic and extremely vascular growths where the positive is used.

ELECTRODES: In order to obtain the effects of one of the poles independent of the other, just as in the application of the Galvanic current for its therapeutical effects, there must be employed an active and an indifferent electrode.

The latter may be either a large sponge, or what is better, an Apostoli clay electrode sufficiently large to spread the current over such an area that the individual polar effects will be destroyed; while the former depends entirely upon the purpose for which it is intended as to form and shape, and will be described under each individual disease mentioned.

REMOVAL OF HAIR BY ELECTROLYSIS.

One of the most uncomely sights afflicting some women is an unnatural growth of hair in the face simulating whiskers. Not only is this disfigurement a source of great embarrassment to the one so afflicted but also, when abundant may cause such extreme sensitiveness as to bring about a state of melancholia.

While the operation may appear very simple, yet in order to perform it successfully without producing much pain and, what is most desirable, without leaving scars, requires no little amount of dexterity and familiarity with the current on the part of the operator. There is slight pain attending the operation no matter how skillfully the manipulations may be performed, but by the careful observation of certain precautions hereafter spoken of it can be very easily borne.

The apparati requisite for the operation are: a good Galvanic battery of from twelve to eighteen cells, a steel needle or broach, a needle holder, and a pair of epilation forceps. The battery must be in good working order so as to insure a steady and uniform current

The strength of current necessary to destroy the hair papilla varies from eight to fifteen milliamperes, well developed hair requiring a proportionately stronger current.

As the active electrode, an ordinary steel needle answers all purposes. It should be very slender and besides have a sharp point in order to facilitate its introduction and cause the least possible pain, and also to avoid all risks of any scars resulting from the operation.

The needle-holder should be fitted with a current-breaker so that the operator is enabled to close and break the circuit without disturbing the position of the needle in the least.

In this operation the active electrode is attached to the negative pole of the battery.

The inactive electrode may consist of a large sponge hand electrode which is to be firmly grasped by the patient.

As this operation is very trying to the eyes, the operator should be so seated that the light will strike his back obliquely, and at the same time fall directly upon the part of the patient's face to be operated upon. This is best accomplished by having the patient to recline

in an operating chair in which the head may be either elevated or lowered in order to take advantage of the best possible light, and also to afford the operator the least tiresome position.

Magnifying glasses have been devised for this operation, but besides being an injury to the eyes, they will be found of very little actual service.

MODE OF OPERATION: After having tested the current to be sure that the battery is in proper working order, and having arranged the position of the patient properly, the operator, to insure a steady hand, rests his arm either upon the shoulder of the patient or upon the side of the chair, and instructs the patient to grasp the sponge electrode. The needle is then carefully introduced along the side of the hair shaft, and parallel with its axis to the depth of two lines, until it reaches the papilla. The circuit is then closed by pressing upon the button in the interrupted handle. In a few seconds there will appear by the side of the needle a slight froth, which indicates that the hair papilla has been punctured and destroyed. The needle is retained in position from ten to twenty seconds, after which the current is broken, and the hair withdrawn. If the hair comes away when grasped with the forceps without any traction, the destruction of the follicle may be regarded as complete, and the needle may be withdrawn with the assurance of a permanent removal.

In introducing the needle it is of great importance that it be made to pierce the papilla; and the greatest care should be exercised in estimating the depth to which the needle must be passed in order to reach it, for upon this step depends the entire success of the operation.

Care must be observed that the circuit remain broken, both in introducing the needle, and also in removing it, lest an unnecessary inflammation of the parts be produced.

If there are a great number of hair close together, it is advisable to remove but a few in different places at one sitting, so as to avoid all chances of inflammation.

CASE LIX.—*Removal of Hair:* A large, corpulent woman, with a few scattering hair on her chin and angle of the upper lip, applied to have them removed by electrolysis. In operating upon this case I grasped the hair with the forceps before introducing the needle, in

consequence of which it would come out in a few seconds. At least fifty per cent. returned. I subsequently operated by introducing the needle before grasping the hair, and retaining it until a marked troth would appear. Following this none returned.

CASE LX.--*Removal of Hair*: Female, aged forty; had an uncommon growth of hair on her upper lip. She was very nervous and sensitive, and after extracting half a dozen I was compelled to discontinue operating, owing to the pain it caused her. When she returned on the following day I kept her lip moist with a ten per cent. solution of cocaine for about ten minutes before introducing the needle. In this way I was enabled to remove twenty hair without causing much pain. I continued to remove from twenty to thirty for three successive days, then waited a week, and removed the remainder. As a result of this operation, but a very few returned.

CASE LXI. *Removal of Hair*:—Young lady, twenty three years of age; had a luxuriant growth of long, dark hair on both sides of her face, chin, and upper lip. She had grown quite melancholy, and her health was considerably affected in consequence of this condition.

I began by taking out twelve hair from the side of her face at the first sitting. She bore the treatment without the least sign of pain. On asking her if the operation did not hurt, she said yes, but that she had made up her mind to have them out, and was determined to stand it. I removed from twenty-five to forty daily, operating upon different parts of the face each time, and had taken away about a thousand when she was compelled to leave the city on account of a death in the family. She returned after two months' absence, and on examination I found that not more than three per cent. had returned, and no evidence of scars whatever.

REMOVAL OF TUMORS, ANEURISMS AND MORBID GROWTHS.

Tumors and morbid growths are of frequent occurrence, both within and upon the surface of the body, in locations where removal by means of the knife would subject the patient to great danger, or, if the morbid growth be located in the face or upon the neck, would leave a

very objectionable scar. Here the use of electrolysis will prove of great advantage, and, in many instances, equally beneficial to any of the more dangerous procedures.

In all operations for the removal of growths about the face or neck where the cicatrix following the cutting mode of destruction would be as great a disfigurement as the growth itself, the use of the electrolytic needle, which leaves no subsequent scar whatever, yields happier results than any method that may be employed.

It has heretofore been demonstrated how the Galvanic current will decompose the electrolites contained within tissue. In accomplishing this, the current at once becomes destructive to the cell life and proliferation which forms the basis of all growth of either healthy or morbid tissue. Mild currents will produce these same chemical changes, as well as will the stronger, and while they are not near as rapid in producing the desired effect, yet they are attended with no inflammation, free from danger, and hence as a rule preferable. If however the growth is so situated that its inflammation is of no moment, it may be removed more rapidly by the use of the strong current.

ANEURISMS.

The treatment of aneurisms of small arteries by electrolysis is unattended by any danger whatever. This can not however be said of aneurisms of the aorta or of the larger arteries near the heart, for in these vessels it requires great precaution on the part of the operator lest he produce a rupture of the sac in passing the needle.

The object to be attained in the treatment of aneurisms by electrolysis is to cause a fibrinous deposit within the sac, sufficient in quantity to fill it and prevent the circulation of blood through its cavity.

The operation is performed by attaching a gold or platinum needle to the positive pole of the battery, and passing it well into the sac.

The strength of current may vary from five to twenty-five milliamperes and should be passed from five to ten minutes, depending upon the size of the tumor and effects produced.

Under ordinary circumstances one application of the current will suffice, although at times it will be found necessary to repeat the operation.

CASE LXII.—*Aneurism of the Arch of the Aorta:* About ten years ago I was asked by Dr. W. E. Rogers to assist him in operating upon a case of aneurism of the arch of the aorta that extended up above the clavicle. The man was about forty years of age, very much prostrated, and had suffered with dyspnoea for a long time. He had been subjected to various methods of constitutional treatment without being benefited in the least, and as the sac was in constant danger of being ruptured, owing to the thinness of its walls, it was decided to operate by electrolysis.

The mode of operation pursued at that time was to introduce needles from both the anode and cathode into the cavity of the sac. This was done by inserting a needle on each side of the tumor, and a current of twenty-five cells strength (milliamperemeters being then unknown) way used for about ten minutes. The pain during the passage of the current was intense, and the shock of the operation caused alarming dyspnoea which continued for several minutes after the withdrawal of the needles. It was noticed that when the cathodal needle was withdrawn there occurred a considerable escape of blood, while none followed the removal of the anodal needle. On the following day there was considerable inflammation and enlargement of the tumor. The side upon which the anodal puncture had been made was thicker and firmer, while that of the cathodal puncture was thinner, and threatened rupture. It was evident at a glance that the positive electrode had been of benefit in strengthening the walls of the sac around it, while the negative had weakened its walls. He was advised to submit to a second operation, in which I intended to use the anodal needle only, and attach a sponge electrode to the cathode. He however refused, saying that the pain would kill him.

He died a few days thereafter from rupture of the sac at the point where the cathodal needle had been introduced. The autopsy revealed a thick, fibrinous deposit surrounding the point where the anodal needle had penetrated the sac, while that part subjected to the influence of the cathode were extremely thin.

This case, I think, demonstrates fully the electrolytic polar effects of the current.

CASE LXIII.—*Aneurism*: Twenty-seven years of age; was cut in the forearm in September, 1886; the wound healed after considerable inflammation and suppuration had taken place. In January, 1887, I was consulted in regard to a tumor that had developed to the size of a hazel-nut near the cicatrix. On examination I found it to be an aneurism.

On the following day I operated by passing a gold needle attached to the anode into the sac, while the patient held the cathodal sponge electrode in his hand. The strength of current was gradually increased from three to twelve milliamperes, and allowed to flow for fifteen minutes. During the whole of the operation the patient experienced but very little pain. After withdrawal of the needle and examination of the tumor, it was found to have changed from its former soft pulsating state to that of a firm fibrinous mass in which pulsation was entirely absent. On the following day it was somewhat swollen and tender, but after the second day this had almost entirely subsided. When I again saw him, a month after the operation, the tumor was scarcely perceptible.

VARICOSE VEINS.

Varicose veins are treated in the same way, and with the same instruments employed in the treatment of aneurism.

As the object in the use of electrolysis here is to produce a fibrinous deposit and occlude the flow of blood through the enlarged vessels, the active electrode is attached to the positive pole just as in aneurism.

As these veins are in close proximity to the skin, it makes the operation necessarily very painful.

CASE LXIV. — *Varicose Veins*: The first case I ever operated upon was a man forty years of age, whose internal saphenous vein and its immediate branches over the tibia had become varicosed. I passed two very small gold needles, attached to the anode two inches apart, into the principle vein. A current strength of ten milliamperes was allowed

to flow for fifteen minutes. A firm coagulum occurred about each needle. The pain was so intense that he would not submit to another sitting, though the operation upon the veins treated was a complete success.

CASE LXV.—*Varicose Veins*: Male fifty-five years old; was treated in the same way, except that a milder current (five milliamperes) was used. He complained of such intense pain that I was compelled to withdraw the needles after three minutes treatment. The veins became somewhat inflamed at the points where the needles had been introduced, but on subsidence of the inflammation it was found that they had been reduced to about half their original size. He would however not submit to another operation.

CYSTIC TUMORS.

In the treatment of cystic tumors by this method the current should be just so strong as to produce inflammation sufficient to interfere with the secretion of fluid within the sac, still not of such a strength as to produce suppuration, unless it occupies such a location that the scar resulting therefrom will not be exposed.

In these operations the electrolytic needles are attached to the negative pole, and a current strength of not more than five milliamperes employed if specially desired to avoid suppuration and a subsequent cicatrix. If so mild, the flow of the current must be continued for a longer time than when a ten milliampere current is used.

CASE LXVI.—*Cystic Tumor of the Wrist*: Young girl, aged fourteen; had a cystic tumor on the dorsal surface of her wrist that had been there for five or six years, in which time it had grown to the size of a pigeon's egg.

She was anxious to have it removed without leaving a scar, and so was sent to me to have it operated upon by electrolysis. I introduced the cathodal needle, and used a current of five milliamperes for ten minutes. The pain was very slight. There followed some inflammation, which lasted for three days. After this had subsided I again introduced the needle but this time used a ten milliampere current.

The pain attending this operation was more intense. The tumor was very tender and red for several days thereafter, and at the point where the needle had been introduced threatened suppuration. This subsided in a week's time, and the tumor diminished to half its original size.

I thought it might be necessary to operate again before it would entirely disappear, but decided to wait several weeks to see if it still decreased in size. At the expiration of a month it had so nearly disappeared that I concluded not to operate again.

CASE LXVII.—*Cystic Tumors*: Girl, aged four years; had two cystic tumors on the palmar surface of her wrist. I introduced a cathodal needle into both at the same time, and used a current of ten milliamperes for eight minutes. The pain was slight. For three days the tumors were very much inflamed, and suppurated slightly at the points where the needles had been introduced.

The tumors entirely disappeared in a month's time, and the wounds healed without leaving any signs of a scar.

CASE LXVII.—*Hydrocele*: Boy four years of age; had trouble in passing his urine ever since he was a few months old, the number of micturitions being frequent, the quantity large and usually attended with pain. Six weeks before bringing the child to me the mother noticed an accumulation of fluid in the scrotum. On examination I found adhesions of the prepuce. Thinking that a great part of the trouble might be due to this, I performed circumcision. The frequent number of micturitions were corrected, but the hydrocele still persisted. I then decided to operate upon it by electrolysis. Two cathodal needles were introduced upon each side of the tumor, and a current of eight milliamperes allowed to flow for five minutes. Very little tenderness followed the operation, and the patient was not benefited in the least.

After waiting a week I used twelve milliamperes, and continued the application for ten minutes. This was followed by considerable tenderness and swelling, during subsidence of which the fluid was absorbed and the hydrocele cured.

Some authors advise the use of both anodal and cathodal needles in this operation. Anodal needles I do not think should be used, for

the reason that in causing albuminous coagulations within the sac suppuration is very apt to follow, and thus very seriously complicate the trouble.

CASE LXIX.—*Tumor at the Elbow Joint:* Male, fifty years of age; was brought to me by Dr. Crawford, of this city, for the purpose of having a tumor situated over the olecranon process removed. It was about twice the size of a hen's egg, and of a firm consistence. He refused to have it cut, but was willing to have it operated upon by electrolysis.

I introduced two cathodal needles, one on each side of the tumor, and passed through it a current of twelve milliamperes for fifteen minutes. When he returned, three days after the operation, the tumor was still swollen and tender, but also somewhat softer. It was again treated in the same way as before. The pain attending this operation was somewhat severer than it had been during the first. He was instructed to return in a week. When he did so I found the tumor very much smaller, and quite soft. On examination a month thereafter it had entirely disappeared.

ELECTROLYSIS IN ORGANIC DISEASES OF THE UTERUS AND ITS APPENDAGES.

I have in a previous chapter discussed the benefits derived from the use of the Galvanic and Faradic currents in the treatment of functional disorders of the womb and its appendages. In the treatment of organic disorders however, where the existing symptoms indicate either a chronic inflammation of any part of the organ, or the presence of a tumor, or some other structural change where in order to effect a cure it is necessary to produce some impression upon the parenchyma of the organ in addition to tonicity or stimulation, treatment by electrolysis is indicated.

The morbid conditions in which I have made use of electrolysis, and from which I have derived any beneficial results by subjecting my patients to this mode of treatment, frequently after all other methods like those of tamponing and the routine application of various astringents had failed, are: Chronic peritonitis and cellulitis, congestive

hypertrophy of the uterus, endo-metritis and endo-cervicitis, ovaritis and salpingitis, subinvolution, fibrous and cystic growths, and displacements.

In the treatment of uterine diseases by electrolysis, it is frequently of great advantage to employ in conjunction either local or general applications of the Faradic current, in order to promote the tonicity of the affected parts, and also to correct the effects that this morbid condition may have produced upon the general system.

CHRONIC PERITONITIS AND CELLULITIS.

There are no other types of female diseases that so effectively baffle the skill of the gynecologist, and set at defiance all his methods of treatment, as those arising from a chronic inflammation of the cellular tissues surrounding the uterus and its appendages. Owing to the situation of these thickened conditions, which after copious inflammatory deposits have taken place instead of being absorbed, become organized, persist and even frequently increase so greatly in size as to cause serious displacement of the organs in its immediate vicinity, it is almost impossible to make any impression on this condition by the routine methods of glycerine tamponing and astringent application. True, by the application of iodine or tannic acid, and the use of glycerine tampons and hot water irrigations for a continued length of time, a slow absorption may be promoted, that in some instances may effect a cure, but generally, if this treatment alone be pursued and persisted in, it will foster a condition that subsequently will require a much graver operation for its removal.

It is in these cases that electrolysis, if rightly employed, will prove to be of greatest benefit in bringing about a rapid absorption of the exudates and restoring the inflamed tissues to their normal condition. In all these conditions, whether it be merely the thickening of the walls of the vagina, or inflammatory thickening of the tissue between the cervix and bladder, deposits in the cul-de-sac of Douglass, thickened masses around the Fallopian tubes or ovaries, or even a peri-uterine engorgement of inflammatory tissue that produces a displacement of the organ, electrolysis is the only means by which a rapid and effective absorption of the exudates can be promoted.

Prominent among the general symptoms of these varied conditions we may find painful menstruation painful urination, constipation, pain in the back, and neuralgic pains radiating down the limbs and over other parts of the body.

CASE LXX. *Chronic Parametritis with Inflammatory Deposits in the Cul-De-Sac of Douglas*.—Mrs. H. thirty years of age came to me complaining of painful menstruation; a very obstinate constipation, her bowels never moving unless by the action of large doses of purgatives; difficulty in passing water, the micturitions being frequent and very painful; constant backache and "bearing down," accompanied by a feeling of soreness in her pelvis. She was the mother of two children; had been in perfect health up to the birth of her last, which was attended with a very severe and long labor. The first thing she noticed after recovering therefrom was a feeling of languor coming on of an afternoon, following a morning's devotion to her usual household duties. As this condition soon presented a more serious aspect, she consulted one of the principle gynecologists of her town, who upon examination discovered inflammatory deposits within the cul-de-sac of Douglass. He made local applications of iodine, used glycerine tampons, and hot water irrigations with a view of absorbing the exudation; treating her in this way for four months without the least indication of improvement.

Finding that instead of being benefitted by this mode of treatment she was gradually becoming worse, she concluded to try electricity as a last resort prior to an operation, which had been told her by another gynecologist whom she had consulted was the only means of affording relief in such a condition.

On physical examination I found a large mass of inflammatory deposits in the recto-uterine fossa that had produced a marked displacement of the organ. The uterus itself was firm and resistant to the touch, while the upper part of the vagina gave a cartilaginous feel, and showed extreme tenderness. Rectal examination revealed considerable thickening of its anterior wall.

Treatment was instituted by introducing a vaginal electrode connected with the negative pole of the battery, and allowing a current sufficiently strong to produce a slight burning sensation to flow for about ten minutes. Each alternate day a rectal electrode was used instead of

the vaginal, and introduced as near as possible to the deposit. Whenever the vaginal electrode was used, the Apostoli clay electrode connected with the anode was placed upon the back; while, when the rectal electrode was used, it was placed over the abdomen, so as to cause the current to flow directly through the deposit. This treatment was given three times a week, except during the menstrual epoch.

After a very few applications the pains in her back began to disappear, and her general health showed signs of improvement. At the end of several weeks there was considerable softening of the tissues in the region of the deposit, and in a few more weeks there had been such a decrease in the size of the mass that the uterus assumed its normal position. Improvement progressed rapidly, and at the end of three months she was perfectly well.

CONGESTIVE HYPERTROPHY OF THE UTERUS.

This condition of the uterus is very common. It is due to a passive or venous congestion taking place within the organ, and, if uncomplicated, generally yields readily to electrical treatment. If allowed to persist for any length of time however, other more serious organic troubles usually supervene, and render the treatment by far more difficult.

In uncomplicated cases of congestive hypertrophy, the stimulating effect of the Faradic current is mostly to be relied upon, and its external application by means of the cabinet vapor bath frequently constitutes all necessary treatment.

Where there are marked complications, which usually give signs of their existence by the severity of the menstrual epoch, this treatment alone will not suffice, but in addition the vaginal electrode should be introduced, and the Galvanic current used at least twice a week. In cases of severe inflammation of the intra-uterine membrane, accompanied by profuse leucorrhoea, it will frequently be necessary to use a uterine electrode attached to the negative pole of the battery.

CASE LXXI.—On January 5th, 1883, Mrs. M. applied to me for treatment. She was suffering with a constant leucorrhoea, difficult and painful micturitions, pain in her back, and intense dysmenorrhoea.

Her menses usually lasted ten days; the flow was very profuse, and prostrated her to such an extent that she would hardly recover from one period before the approach of another.

On physical examination I found the uterus very much hypertrophied, the cervix congested, and the mucous membrane of an unnatural color.

I introduced a vaginal electrode attached to the negative pole, and passed the current for about fifteen minutes three times a week. In conjunction she was given a cabinet vapor bath on alternate days. This treatment was continued for a month and accompanied by marked improvement. I then introduced a uterine electrode twice a week, and continued the use of the cabinet bath. In 'two months' time she was entirely relieved of her trouble.

ENDO-CERVICITIS AND ENDO-METRITIS.

The most frequent and troublesome diseases of the uterus with which the gynæcologist has to contend are ulcerations or erosions of the neck, and chronic inflammation of the mucous membrane lining the body. The causes giving rise to these conditions are as varied as are the disturbances of the organ itself, for the reason that most any morbid condition, either organic or functional, is usually followed by pathological changes in the lining membrane of the uterus, if the disease be permitted to continue for any length of time. The leucorrhoeal discharges resulting from this inflammatory condition, besides being debilitating by their continual drain upon the system, are constantly bathing the mucous membrane in irritating fluids, which in turn give rise to structural changes within the organ itself. In this manner leucorrhoea may be the cause of subsequent morbid conditions of the uterus and vagina (a secondary cause capable of producing its individual effects upon the organism), but as to its being a disease per se, with a sufficiently delineated train of symptoms to mark its individuality free from a dependence upon pre-existing conditions, pathology has never been able to demonstrate. By far more rational would it be to regard leucorrhoea as the result of the disturbance of the uterine circulation, rather than its cause; and that the discharge is an index to a more hidden trouble, and not the disease itself.

If then a leucorrhoeal discharge owes its origin to a perverted condition underlying the mucous membrane lining the organ, it is evident of what little benefit it is in removing, by the pernicious application of astringents, a sequence, instead of aiming to remove the cause by agents that can be made to act directly upon the diseased parts.

The same may also be said of ulcerations of the cervix. Emmet says: "If the so-called ulceration of the cervix is accepted as a cause, and not as an effect, the use of caustic applications is a consistent practice, and should be persevered in until the surface has been healed. But if it is held that the increased secretion is simply an attempt of nature to relieve an obstructed venous circulation, and that the erosion is a surface from which the epithelium has been washed away by the discharge constantly flowing over it, then such a course of treatment is to be deemed, not only irrational, but most hurtful.

"When an erosion has been healed by caustic applications, the health of the woman improves rapidly, since, for the time, a great leak has been stopped, by which she was constantly pouring out her life-blood in the form of leucorrhoeal discharge. But, as the primary cause is not removed, the erosion must return again and again until at length, if the treatment is continued, every mucous follicle will have been destroyed, and no further discharge can take place; but the hypertrophy of the uterus, and the abnormal condition of the pelvic circulation will remain. If the application is strong enough to produce a slough, then, of course, the mucous follicles will be destroyed; but even if milder means, as the use of nitrate of silver, are persevered in long enough to heal the surface, the damage will be quite as great, since the tissues will have been rendered sufficiently dense to cause atrophy of these follicles, and, after either mode of treatment, the tissues become essentially cicatricial in character.

"As the profession has for years been familiar with the effects of the cautery and caustics on mucous membranes in other parts of the body, it is remarkable that their use should still be continued in the treatment of the diseases of the female organs of generation. Yet conscientious men of our day, after the use of the cautery or caustics, will leave a surface on the vagina or cervix to heal by granulation, and will deny that the surface thus formed is cicatricial, or that it ever contracts; and I have no reason to doubt that they think so, but I do im-

pugn the accuracy of their observation, and the wisdom of their measures."

CASE LXXII — *Endo-Metritis*. Mrs. E, aged twenty-four; married seven years. She became pregnant at the age of twenty, and had a miscarriage three and a half months thereafter. There was a considerable loss of blood, and her recovery from the effects of it was quite slow. Two months after the mishap she again had profuse hemorrhage accompanied by clots, which she thought were parts of the placenta that had not come away entirely at the time of the miscarriage. During subsequent menstrual periods, metrorrhagia was a constant accompaniment. She became very much reduced in health, lost strength, and was troubled with constant neuralgic headaches, and pain in her back. As the treatment by local applications was not giving her any relief, she concluded to come to me for electrical treatment.

On examination I found a very congested cervix, marked endometritis, and anteversion. The organ was very sensitive, and the introduction of a uterine sound produced considerable pain.

I began treatment by introducing a vaginal electrode attached to the negative pole, and passed the current every third day for a week, at the same time advising her to use daily irrigations of hot water. Following this I introduced a uterine electrode, and passed a current of ten milliamperes strength for twenty minutes. A discharge of blood-clots followed the first introduction, after which she felt a marked relief. This treatment was then given twice a week, and in conjunction she took daily electric cabinet vapor baths in which the Faradic current was passed directly through the organ. Four months thereafter I dismissed her entirely cured. She has since conceived and given birth to a healthy child.

CASE LXXIII.—*Endo-Cervicitis*. Mrs. M, aged thirty-three; very delicate and anaemic. She came to me with the following history: Mother of four children; at the birth of the last three years ago she had a very hard and long labor from which she recovered slowly, and following which she suffered an almost constant leucorrhoeal discharge and frequent hemorrhages. These discharges continued growing worse, and she applied to her family physician for treatment. He prescribed an astringent injection to be used locally, and as internal treatment gave her a bitter tonic. She improved considerably for a

short time, after which she became as feeble as before and besides suffered with almost constant pains in her back. At nine months she stopped nursing her child, and again placed herself under the care of her physician. He then gave her cod liver oil, malt, and iron with a view of relieving the trouble by building up her general health. This time she was not benefited in the least, and the constant leucorrhoeal discharges so enfeebled her that she was confined to her bed for most of the time.

She was then placed in charge of a gynaecologist, who made some local applications to the cervix. Following this the discharge became less abundant, and her general health improved. She was under his care for four months when she was pronounced well, and dismissed from further treatment. A few weeks after discontinuing treatment the discharges reappeared, and she soon relapsed into her former condition.

She then applied to me for electrical treatment. On examination I discovered erosions of the cervix covered with thick viscid discharges. The uterus was considerably hypertrophied and slightly anti-flexed. On close examination of the cervix I found cicatricial contraction, the result of caustic applications that had considerably narrowed the os.

I introduced a uterine electrode attached to the negative pole, and passed a current of ten milliamperes for eight minutes. This was done every third day. In connection with this treatment on intervening days she was given an electric cabinet vapor bath with the electrodes applied to her back and over her abdomen. Improvement was very rapid. The baths were discontinued after the first month's treatment, and the uterine applications made but once a week.

In three months I dismissed her entirely relieved. She has been under my observation ever since and thus far has had no return of the trouble.

CHRONIC OVARITIS AND SALPINGITIS.

This condition of the ovaries and tubes is very similar to that of pelvic inflammation, and is frequently associated with it; especially is this the case in a general pelvic peritonitis, where they seldom escape. As a result of this inflammation, there is a deposit of exudates

which, on hardening, contracts and partly destroys the function of the parts: the circulation is impeded, and a congestion of the organ ensues. Besides, by the firm contraction of the mass upon the nerves supplying these parts there is produced the ovarian neuralgias so common among women suffering with menstrual disturbances.

In these troubles where the inflammatory deposits are not too great, and where the disease has not been of too long standing, great relief may often be obtained by the judicious use of electrolysis that can be gotten by no other non-surgical procedure; and in most cases, to say the least, is worthy of trial before resorting to removal of the ovaries.

CASE LXXIV.—*Ovaritis*: Mrs. L. thirty years of age; consulted me in regard to a pain in her side, that had been increasing in severity for four years. The pain, though almost constant, was always intensified after moderate exercise, and shortly before the appearance of her menstrual epoch.

Upon physical examination I found great tenderness on pressure over the right ovary, and immediately within the most sensitive area a deposit simulating a prolapsed ovary.

I introduced a vaginal electrode attached to the cathode and placed an Apostoli clay electrode over her abdomen. The current was gradually increased to five milliamperes, as strong as she could bear it without causing severe pain. This was done three times a week, and at the end of the second month's treatment the pains had entirely disappeared, her menstruation was normal, and the mass of deposit had been reduced to half its original size. The treatment was then given at longer intervals, and by the end of the fourth month, the deposit having entirely disappeared, I dismissed her from further treatment.

SUBINVOLUTION.

The term subinvolution is applied to that condition of the uterus where from some cause it fails to return to its normal size after gestation.

The most prominent etiological factors that have come under my observation are; defective nutrition, depression following long and

tedious labors, resuming household duties too soon after delivery while the womb is still large and heavy, and most common of all, the neglect of proper hygienic precautions during and immediately following child-birth.

This condition is seldom uncomplicated if it has existed for any length of time, and accompanying it we may either find some form of displacement, frequently prolapse, endo metritis, or probably a multiplicity of other complications.

If of not too long standing, and unattended with grave complications, it generally yields readily to electric treatment. The object of the treatment here is to restore the tonicity of the organ, improve its circulation, promote contraction of its muscular fibres, and cause the absorption of the remaining hypertrophied tissue. To accomplish this, both the Faradic and Galvanic currents must be employed. The Faradic is best applied by means of the cabinet apparatus, in which the electrodes are so arranged as to cause the current to flow directly through the organ. The Galvanic should be used, by means of the uterine electrode attached to the cathode and introduced into the cavity of the organ, at least twice a week. The current should be very mild and the sitting last about fifteen minutes.

CASE LXXV. *Subinvolution*.—Mrs. L., aged thirty-five, consulted me in March, 1889, for general weakness and bearing down pains that she was suffering almost constantly. Four months prior she had given birth to a third child. The labor was very long and severe. Her menses appeared the second month after the confinement, but were attended with considerable constitutional disturbance.

On examination I found a large uterus that had undergone slight displacement. The cervix was soft and flabby.

I used the Galvanic current twice a week, applied in the manner described, and had her take daily cabinet baths in which the Faradic current was used. She improved in strength very rapidly, and by the expiration of a two months' course of treatment she was entirely relieved of her trouble.

FIBROID TUMORS OF THE UTERUS.

The destruction of fibroid tumors of the uterus by electrolysis affords

the gynecologist a means by which to remove these growths in a far safer way than by the performance of laparotomy. Though it cannot be asserted with positive assurance that this method will be successful in the destruction of every fibroid no matter of what form or size; still, as it has proven successfully in a large number of cases reported by numerous operators who have tried it, and as it is an operation unattended with the least danger if rightly performed, there is no reason why it should not be made trial of in each case before resorting to more grave procedures.

To insure a successful operation, and at the same time avoid all serious complications I deem it preferable to use a milder current than that advised by Apostoli and others. The only danger attending the operation, if the needle has been properly introduced, is the use of too strong a current and its passage allowed for too long a time. If we consider the physiological effects of the current it is obvious that it is not the purpose of the current to destroy the tumor by its thermal effects, but rather to chemically decompose the electrolytes within it, and thereby undermine its structure by removing a number of its essential constituents. The tumor no longer containing certain necessary ingredients becomes disorganized, the cations evolved into its parenchyma are absorbed, and as a result it atrophies and disappears.

My method of operating is as follows: I attach a large clay electrode to the anode and place it either upon the abdomen or back, depending upon the location of the tumor. To the cathode is attached a steel needle well insulated to within a few lines of its point. If the tumor is situated upon the anterior aspect of the uterus, as in Fig. 27,

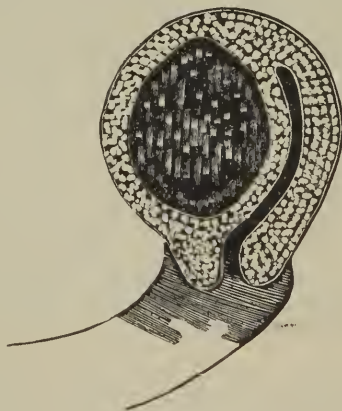


Fig. 27.

the clay electrode is placed upon the abdomen, and the needle passed into the body of the growth in such a way as not to penetrate the peritoneum, if this can possibly be avoided. In order to avoid all danger of puncturing the bladder, it is advisable in operating upon tumors situated either within or external to the anterior wall to pass the needle through the body of the uterus from within its cavity outward. Whereas, if the growths are located as in Fig. 28, the needle may either be introduced by passing it through the body of the organ as before, or by reaching them by way of the cul-de-sac of Douglass, since inflammation of any gravity is not as likely to be aroused here as in the cellular issue bordering the anterior wall.



Fig. 28.

The electrolytic current of the strength of one milliampere should then be allowed to flow, and this gradually increased without interrupting the circuit until the strength of current ranges from fifteen to twenty milliamperes, depending upon the tolerance of the patient. The current is allowed to flow from ten to fifteen minutes, or if the pain be not severe the sitting may be prolonged, but never beyond thirty minutes. After waiting about five days, or until all acute inflammatory symptoms produced by the operation have disappeared, the current is again passed in the same manner as before, except that, if it can well be tolerated by the patient, the strength is increased by several milliamperes.

It must be borne in mind that mild currents will produce the

same electrolytic effects as will strong, though not as rapidly and in as few sittings. The only object in employing a current as strong as possible without creating serious disturbance is to lessen the number of sittings, and thereby cause a more speedy disappearance of the growth.

CASE LXXVI.—*Fibroid Tumor of the Uterus*: Mrs. Y. of Mississippi, aged forty, consulted me in regard to a pain in her right side and menorrhagia. Without making a physical examination I wrote a prescription which I thought would soon relieve her. In a few weeks she returned with the same trouble, and I again prescribed for her. She again returned, saying that the medicine had not benefited her in the least. I thereupon made a uterine examination and found a fibroid tumor about the size of a hen's egg on the right side of the uterus. I kept her under treatment for several weeks in order to build up her general health, and on March 3, 1888, seeing that her health could not be improved, I operated by electrolysis.

The large clay electrode attached to the anode was placed upon the abdomen, and a steel needle connected with the cathode was carried into the uterine cavity, and from there passed directly into the tumor to the distance of about half an inch. The current was gradually increased to fifteen milliamperes, and allowed to flow for eight minutes. The pain was not very intense.

There was some tenderness and inflammation on the following day, but it gradually subsided without producing any unpleasant symptoms. Five days thereafter I performed a second operation similar to the first save that the current was allowed to flow for eight minutes. The inflammation and tenderness following this was slightly greater, but no bad symptoms appeared, and in a few days had again entirely subsided. A third operation was performed in a similar way, and was followed by no unpleasant symptoms. Following the fourth operation it was found on examination that the tumor had been reduced to half its original size, and was of a much softer consistence. I then waited two weeks before performing the fifth operation, and on examination, a few days thereafter, found that the tumor had been reduced to one-fourth its original size and was now quite soft. By this time the patient had improved greatly in health, and was feeling as well as she ever felt.

I examined her a month thereafter, and found that the tumor had entirely disappeared.

DISPLACEMENTS.

PROLAPSUS UTERIOR FALLING OF THE WOMB. This disease of the womb, which is so common in middle life and old age, is specially suited to treatment by electricity in that, besides being able to overcome the usual chronic inflammation resulting from this condition of the organ by means of the electrolytic current, tonicity may also be given to its parenchyma by means of the Faradic current sufficient frequently, to effect a complete restoration.

The conditions vary in degree from slight downward displacement to a complete protrusion of the organ from the vulva. The etiology of the displacement of the organ may usually be referred to a pre-existing chronic inflammation that has produced a congestive hypertrophy, is followed by a sub-involution after child birth and a subsequent relaxation and atony of the walls of the vagina which, failing to give support to the organ, allows its prolapse. These conditions may at times vary, but as a rule, falling of the womb may be traced through these stages.

To restore the normal tonicity of these parts the vaginal electrode should be introduced, and the Faradic current employed for from fifteen to twenty minutes on alternate days. The electrode should be introduced well into the vagina, so as to come into contact with the external os, while the indifferent electrode may be placed upon the abdomen.

The uterine electrode should be introduced into the uterine cavity twice a week, and both the Faradic and Galvanic currents be applied, the former to restore the normal tonicity to the walls of the organ, and the latter to influence its circulation and at the same time, by its electrolytic effect, influence whatever morbid conditions that may exist within the mucous membrane lining its cavity.

In using the Faradic current, it is of no import to which pole the active electrode is attached, as both are similar in effect: but in the use of the Galvanic, the uterine electrode should be attached to the cathode.

The current should gradually be increased to a strength of from twenty to seventy-five milliamperes.

CASE LXXVII. — *Prolapsus Uteri*: Mrs. M. B., twenty-seven years of age; the mother of three children. She had natural labors and rapid

recoveries attending the birth of all three, leaving her bed on the eighth day after the first and second, and the fifth day after the third. Shortly after the birth of the last child she began to have pain in her back and, as she described it, "a bearing down feeling" in her abdomen. She paid but little attention to it however and continued her household duties as before. As these "bearing down" pains gradually became worse, and in addition she became troubled with frequent and painful micturitions, she consulted her family physician. He advised her to go to bed, and gave her a wash with which to irrigate the vagina and womb. At the expiration of a week she was able to be up again, but still suffered considerably with pains in her back and on passing urine. She then sought the advice of a gynaecologist, who diagnosed prolapse of the uterus with anteversion. He treated her by means of astringent applications for three months without benefiting her in the least. He then introduced a pessary, but this gave rise to so much irritation that it had to be removed. She was then put to bed and kept there until a second pessary that had been introduced could be tolerated. This was removed several times a week for the purpose of making applications to the uterus. Despite all treatment she became no better.

She came to me to be treated for the pain in her back, saying that Mrs. P. had been relieved by the use of electricity and thought she might be benefited also. After hearing the foregoing history of her case I asked to be allowed to examine her in order to see the condition of the uterus. She refused, saying that she would not submit to any more local treatments. As she was very anaemic, I advised her to take several electric cabinet vapor baths. When she had taken them for a week she felt some relief, but not as much as she had expected. I then told her that I could not give her any permanent relief unless she submitted to an examination, and subsequent treatment as I thought proper. She acquiesced. I found the uterus anteverted, with the fundus resting upon the pubes, and prolapsed so that the cervix rested upon the posterior wall of the vagina. The cervix was very much congested and enlarged, and the vagina completely relaxed. Beside there was a slight white, viscid discharge.

I replaced the organ and applied the Faradic current by means of the vaginal electrode for three successive days, following which I introduced a uterine electrode and applied the Galvanic current using a

current strength of twenty-milliamperes. The active electrode was connected to the cathode and the current allowed to flow for ten minutes. Two days afterward she returned for another treatment saying that thus far she had been benefited more than by any other treatment she had ever taken. These applications were made every third day for three months before the uterus remained in position. After this the treatment was given at irregular intervals for three months more, when I dismissed her entirely relieved.

STRICTURE OF THE URETHRA.

The treatment of stricture by electrolysis has attracted considerable attention among the members of the profession within the last few years. Like all new innovations it has been no exception to the rule, and has met with equally strong opposition from some of the adherents to the old methods of cutting and divulsion.

The practical utility of electricity in the treatment of these cases is no longer "*sub judice*," but the array of facts that give evidence of benefit resulting therefrom, has become so strong that it rightfully demands a front rank in the modus operandi of urethral surgery.

In order to treat stricture successfully by electrolysis it is necessary not only to be thoroughly familiar with its causes, pathology, different forms and complications, but also to have a thorough knowledge of electro-physics and the principles of electrolysis. There is no other operation of any kind that requires as much care, attention, and experience with the use of the current as does this. With my experience of ten years, during which time I employed it almost constantly, I would unhesitatingly say that Prof. Keyes, who is the strongest opponent of this method, with his thorough knowledge of the causes, pathology, and different forms of stricture, would fail in the use of electrolysis, and especially so since he was led to regard it as a simple method that could be used successfully by any one, whether he be acquainted with electrolysis or not. Though I believe Prof. Keyes perfectly sincere in his views regarding this method of treatment, still it appears as though too hasty a judgment were passed and not sufficient attention devoted to the essentials of a method, in condemning which its opponent must preface his views with the declaration of perfect lack of

practical knowledge concerning the principle upon which it is founded. The reasons of failure following the trial of a new remedy in this manner are obvious : success would be a mere accident and not a scientific sequence.

Let the principles of this method be studied as thoroughly as are the principles of every other surgical procedure; let the urethra be put into a proper condition before operating, just as in any treatment; and let the operation be confined to those cases wherein favorable conditions indicate its use, and failure will be a rare consequence. Not every urethra is in a proper condition for the use of electrolysis immediately after the discovery of the stricture; nor can every urethra at once be brought to that condition by preliminary treatment, in which the use of electrolysis is justifiable. Hence, electrolysis, like many other surgical operations, can not be of benefit and should not be used in all cases of stricture regardless of the condition of the urethral membrane. If the membrane is very much inflamed and extremely sensitive, and persistently remains in this state despite all treatment, electrolysis is harmful and should never be employed until these conditions are overcome.

Organic stricture is a narrowing of a part or parts of the urethra resulting from an inflammation of the walls of the canal. The most frequent cause is gonorrhoea. The inflammation resulting from this disease causes a plastic deposit in the submucous cellular tissue that in time becomes fibrinous, and encroaches upon the calibre of the urethra. The mucous membrane over the fibrinous deposit is invariably involved to some extent and at times is completely destroyed; or, as is more frequently the case, becomes turgescient or granulated, and presents an exceedingly irritable condition.

The prominent symptoms of stricture are gleet, pain in the back, irritability of the bladder and a frequent desire to void urine, pain before and after passing urine, and a small twisted stream. These conditions often result in cystitis, organic diseases of the bladder and kidneys, melancholia and various nervous disturbances; for, as the urethra is abundantly supplied with sensory nerves, by reflex irritation there is frequently produced disturbances of other organs even most remote from the seat of the trouble.

TREATMENTS BY THE OLD METHOD COMPARED WITH
ELECTROLYSIS.

Several years ago in an article published in the *Mississippi Valley Medical Journal*, I made the assertion that it had been my privilege to meet with a great many unfortunates who had been cut, and that among all these I had never seen a single case that had been entirely relieved. Sir Henry Thompson, one of the leading genito urinary surgeons of Europe in discussing the subject says, "Organic stricture is a permanent condition. Once acquired it cannot be entirely dissipated by any known means. You may dilate it, you may cut through it, but there, more or less, the morbid elements must always remain. When a man once has organic stricture he has it forever." In speaking of treatment, "First and foremost, dilatation, dilatation always, dilatation without exception whenever it will succeed. It is always to be tried first, because it is the safest and easiest method."

Otis, one of the leading genito-urinary surgeons of this country, says, "Operation for the relief of stricture of the male urethra by dilatation, divulsion or incision has been in use from time immemorial; but according to the teachings of surgical authorities throughout the world, strictures are not absolutely cured by any of these methods."

Urethrotomy and divulsion are being laid by by the best surgeons of this country and Europe, both on account of the dangers attending the operation, and also because of the almost universal failure in obtaining satisfactory results therefrom. It has been the custom of conservative and cautious surgeons throughout the world to advise dilatation in preference to cutting or divulsion, because it is practically devoid of danger. Dilatation is possible to a certain degree, but beyond that it is impossible to derive any beneficial effect from it. Is then stricture utterly incurable? If these methods alone are employed, I heartily agree with the authors I have quoted and say, *yes*; if, however, electrolysis be employed, I emphatically answer, *no*. If the removal of a fibroid tumor can be effected, or the disorganizing property of the current be demonstrated in the body by the removal of any other growth as has been demonstrated time and again, why should it be of no avail in the removal of similar substances from the urethra? These fibrinous deposits within the canal are *not* necessarily permanent conditions; a man need *not* have a stricture forever, and

the morbid elements *can* be removed—but never by the knife, divulsion, or sound. Complete dissolution of the morbid mass is necessary, and this can only be accomplished by the electric current. I do not claim as do some of my co-advocates that I am able to cure every case by this method. There are some cases obscurely complicated that cannot be cured. I have made a number of failures, especially when the process was yet new to me and methods of procedure empirical, or in conditions where the prostatic urethra had been severely cut; still, my more recent benefits derived from its use, often in cases where all other methods had even failed to give relief, have fully convinced me of its efficacies in establishing a cure.

METHOD OF TREATMENT.

Prior to the use of electrolysis, one of the more essential requisites is to prepare each case properly before attempting the operation. Individual cases vary so much in regard to tenderness, irritability, amount of granulation, consistence, and length of existence that it requires considerable experience to decide how to prepare and when to begin operation.

When a patient presents himself for treatment for the first time, I ascertain the age of the stricture, the amount and nature of the discharge if there is any, and the amount of irritation before proceeding farther. If there is much tenderness and pain in micturition, it is first allayed by injections and internal medication. After this is accomplished I then introduce a soft French bougie-a-boule to detect the nature of the stricture. If this produces much disturbance on part of the patient I generally wait a few days before concluding my examination. If the stricture has been treated by others (as a large number I treat have been) the urethra is usually so accustomed to harsh treatment that this precaution is unnecessary; here electrolytic treatment¹ may be instituted immediately without preliminary treatment. In those cases however, where the condition is such that hemorrhage will be produced by the mere introduction of a bougie, the use of suitable medicinal applications and gradual dilatation must be persisted in until the urethra has been sufficiently hardened to allow the introduction of a sound without giving rise to unfavorable symptoms. The use of elec-

trolysis, it must always be remembered, is more irritating than the mere use of a bougie or sound, no matter how mild the current, and its employment in cases where the simple use of a bougie causes a flow of blood, would merely intensify existing conditions and add gravity to an already serious trouble.

Here I find gradual dilatation the only available method of treatment, and persist in its use until, by the additional use of other remedies, the hyperaesthetic condition has been thoroughly overcome. Dilatation is performed by introducing a series of graded bougies or sounds, and gradually enlarging the calibre of the constricted portion of the urethra by stretching it. By dilatation not a particle of the deposit can be removed; enlargement of the orifice by stretching the tissue is the sole object, and as tissue can be stretched to but a certain point, beyond which the elastic property of its fibre wears out, dilatation alone never relieves stricture. It is necessary as a precursory treatment to electrolysis in that it hardens the parts and renders them less susceptible to subsequent inflammations, but this is the limit of its usefulness. Electrolysis begins where dilatation ends. After the urethra has been brought to a proper condition, I operate by introducing the smallest urethral electrode that will engage the stricture without passing. The circuit is then closed and the current allowed to flow until the electrode can be made to pass the stricture, which is usually from two to fifteen minutes. The strength of current employed depends upon the tolerance of the patient and the susceptibility of the urethra to inflammation. It is best always to begin with a very mild current, and gradually increase its strength in subsequent sittings in proportion to the amount of inflammation produced by the last. The operation is repeated in seven or eight days, if all inflammation has subsided and a larger electrode introduced. This method is continued until all traces of stricture have disappeared.

In presenting a list of cases I shall frankly select from among my early failures as well as recent cures, so as to substantiate my experience as unbiasedly as possible.

CASE LXXVIII.—*Stricture of the Urethra*: Mr. M. aged thirty-three applied for treatment May 3, 1880. He was suffering with a stricture of eight years' standing. Was operated upon five years before by dilatation; three years thereafter by urethrotomy, following

which sounds had been introduced for six months. From the time urethrotomy was performed he had no trouble in passing his urine, although there was a constant pain and irritation attending it, until shortly before he came to me. By that time the stricture had again become small and there was considerable difficulty in voiding urine.

There was very little tenderness manifested on introducing a sound and it passed readily into the canal for five and a half inches when it met with firm resistance. On removing the sound and introducing a number three French bougie, I was able to pass it after some difficulty, though it produced but little pain or subsequent irritation.

The following day I operated by passing an olive-pointed insulated urethral electrode (Fig 29) into the stricture. I began by using a current from eight Bunson cells (milliamperemeters being then unknown) and as there was no pain increased it to twelve, and later to eighteen cells. In eight minutes the electrode passed the stricture. I then introduced a number eight French bougie, which was followed by a few drops of blood.

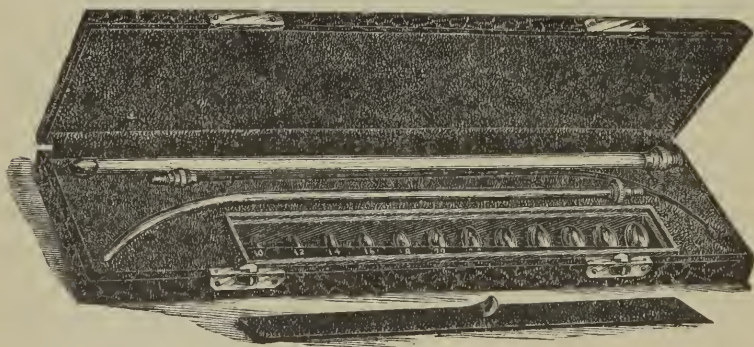


Fig. 29.—Genito-Urinary Electrode Case. (McIntosh.)

The introduction of bougies on alternate days was continued, and on May 12th the current was again passed after a number twelve olive-electrode had been introduced. I used twelve cells and the electrode passed in three minutes. The following day a number twelve French sound was introduced without any difficulty. Sounds were then used twice a week for a month, after which he was dismissed from treatment and thus far has had no symptoms of any return.

At the time I was so elated over the success I had in this case that I thought I would have no trouble in curing any case.

CASE LXXIX.—*Stricture of the Urethra*: Aged twenty-seven; single; of intemperate habits. He had contracted gonorrhoea at the age of twenty-three, which persisted for several months and gradually merged into gleet and a subsequent stricture. His family physician treated him by dilatation for a year but did not give him any relief.

Upon examination I found an exceedingly hyperaesthetic and inflamed condition of the urethra, hemorrhage being produced on the mere introduction of a bougie. There were two strictures; one an inch within the meatus, and the other at the depth of six inches. I was able to pass a twelve French bougie through the anterior, but it was arrested at the second, and through this I could not even pass a number two. I then fastened a number six olive to a urethral electrode, and passing it to the deep stricture, employed a current from eight cells. It passed through the stricture in ten minutes. The pain was intense, and on withdrawing the electrode there followed a considerable flow of blood. I then was able to pass a number six French bougie. He was instructed to return in two days for another operation.

The day after the operation I was called to see him, and to my surprise found that he was suffering considerable pain and could not pass his urine. I attempted to introduce a three French bougie, but failed in passing the deep stricture. Feeling perfectly confident at that time that this condition could not have resulted from the operation I accused him of drinking, but he assured me that he had followed my directions closely and had not touched a drop of liquor. After giving him a hypodermic injection of morphine and placing him into a hot water bath, I succeeded in drawing off his urine. He had trouble in micturition for three days, and even after the acute symptoms had subsided his condition was worse than before I operated.

I then treated him for three months by dilatation, during which time the hyperæsthetic condition of the urethra had disappeared, but the stricture could not be affected. I finally concluded to try electrolysis again by using a milder current. I used a three cell current for four minutes and did not attempt to pass the stricture. After waiting ten days, I applied a current from five cells for ten minutes, and passed the olive into the stricture about one-fourth of an inch.

There was no pain attending the operation and no trouble following it. Three days thereafter, to my surprise, I was able to pass an

eight French bougie. After waiting ten days I again applied the current, using five cells. In twelve minutes a number ten olive electrode was passed through the stricture. I then used bougies for two weeks before using electrolysis, and when I again operated I introduced a sixteen olive and passed it in ten minutes. I have examined the case several times since dismissing him, and thus far found no indications of stricture.

The following case (reported in the *Mississippi Valley Medical Journal*) treated shortly after the preceding, gave me the first clue to the proper method of treatment by electrolysis.

CASE LXXX - *Stricture of the Urethra*: Mr H., aged twenty-five, married; was sent to me by Dr. Sim, of this city, in May, 1883. He had a very irritable stricture, and the urethra was in such a condition that it would bleed freely upon the slightest provocation. I first introduced a bougie, which pained him considerably, and was followed by a copious hemorrhage. Three days thereafter I again introduced the bougie with a similar result. With the urethra in this condition, on the following day I applied a current of five milliamperes. Severe hemorrhage followed the operation, and for more than a week there was considerable inflammation and extreme tenderness. Being disappointed by the result of this operation I concluded to abandon the use of electricity, and treated him first with bougies, and later on, sounds, for more than a month. He improved steadily for awhile, his urethra became less sensitive, and the inflammation and hemorrhagic condition disappeared; but beyond this, the treatment proved of no avail. I finally decided to use electrolysis again, but with a milder current. To my surprise, it acted like a charm. I realized at once the reason of my previous failure in treating inflamed and congested strictures by electrolysis; in that I did not previously prepare the parts for the operation.

He recovered rapidly and has had no trouble since I dismissed him from treatment.

The following is a clinical report of a case I operated upon in the Memphis City Hospital, March, 1873, in the presence of Dr. J. E. Black (the surgeon in-chief) and a class of students; which was subsequently published in the *Mississippi Valley Medical Monthly* by Dr. Watson, the resident physician.

GENTLEMEN : I have before you C. L., white, aged forty four, a Canadian by birth, and tailor by occupation. His history is briefly as follows : In 1863 he had gonorrhoea; in 1870 the first symptoms of stricture were manifested ; and in 1874 he was operated upon by gradual dilatation, which treatment lasted six months. Following this he became troubled with incontinence of urine and suffered considerable during micturition. About five months after the operation he again could not pass his urine without considerable difficulty. This condition continued until 1878, when he was operated upon by urethrotomy and dilatation. The calibre was kept patulous for about two years, when it again closed, and he has been able to void his urine only drop by drop ever since. When admitted to the hospital a few days ago, he was having paroxysms of intermittent fever in addition to his stricture.

I find, upon examination, that the meatus is very much contracted, and will not admit a number one sound (American scales). I will, however, take a small olive, equal in size to a number six sound of the same scale, adjust it to the end of a urethral electrode, attach this to the cathode of the battery and pass it into the urethra until it comes in contact with the stricture. With the anodal sponge electrode in his hand, I pass a current from four cells : as he does not feel this in the urethra I will increase the number, one at a time, until I now have nine cells in the circuit and he feels a slight pricking sensation. I will now gradually increase the number of cells to twelve; he still suffers no pain. I keep the electrode pressed firmly against the stricture, though use no force. The current has been passing eight minutes, and I can feel the electrode enter the stricture. It is now seventeen minutes since the operation was begun, and it has passed into the stricture about an inch, but not entirely through it. Although he is suffering no pain, the current has passed as long as it is practicable ; so I will break the circuit and remove the electrode. The reason I do not pass the current longer is that it might be followed by hemorrhage and inflammation. I shall now introduce a number eleven sound. It passes as far as the

electrode did, but no farther. We will now request him to pass his urine to see if it flows any more freely. It passes only in drops as it did before the operation; but he says it drops faster than it did previously. Upon examining the urine I find there has been no hemorrhage, nor does he have any pain. The operation is not yet completed, but I shall finish it in about seven days.

April 19th: The resident physician, as well as the patient himself, has informed me that on the morning following the operation he passed a very good stream and has continued to do so since. I now introduce a number twelve sound and find that it does not pass farther than the electrode did at the time of the operation. I will begin the second operation by introducing a urethral electrode with an olive tip equal to a number eleven sound, and close the circuit of a current from six cells. The number of cells is gradually increased to nine, and he now feels a pricking sensation. The current has been flowing for eight minutes and the electrode has now entered the bladder. I break the circuit, withdraw the electrode, introduce a twelve sound, and find that it passes into the bladder without the slightest trouble.

May 19th: The patient has been working in the hospital ever since the last operation. He has had no trouble whatever since then and says he can pass as large a stream as he ever could. He suffers no pain during micturition, and is very much improved in general health. I now regard him entirely cured, and furthermore, that the cure is permanent.

CASE LXXXI.—*Stricture of Fifteen Years' Standing:* Mr. M., of Mississippi, aged forty-five; an habitual drinker. He had been suffering with stricture for fifteen years, during which time he had been treated by dilatation (twelve years before) by a physician in Mississippi. Subsequently he was cut by a physician in New Orleans, and later again by a physician in this city. Following the last operation he had a chill and came near dying. He was confined to his bed for six weeks. Every introduction of a sound thereafter would produce a "nervous rigor" that would keep him in bed from three days to a week. On January 3, 1887, I introduced an eight French bougie. The urethra

was so hyperæsthetic that I came near producing a "nervous rigor," although the bougie did not pass through the stricture, which was situated five and a half inches from the meatus.

I instituted treatment by giving him an injection to use three times a day, and triticum repens internally. Upon his return, a week thereafter, the tenderness had somewhat subsided. I was able to pass only a two French bougie, and this fitted the stricture tightly and caused some pain. He was instructed to continue his medicines and return in four days. By this time the hyperæsthesia had very much decreased, but the stricture was as narrow as before. The bougie was again introduced. This treatment was pursued for two months and attended by marked improvement.

Finding that I could not reduce the tenderness of the urethra any farther, for the reason that, owing to the difficulty in voiding his urine, he could never entirely empty his bladder, even though there was still considerable tenderness, I decided to operate by electrolysis. On March 5th, I attached a five olive to a urethral electrode, introduced it down to the stricture, and passed a current of five milliamperes. The current was gradually increased to twelve milliamperes, and allowed to flow for ten minutes. He suffered some pain during the operation, though no unpleasant symptoms followed. As the olive did not pass through the stricture, I told him to continue the local medicinal injections and not introduce a bougie for ten days. On March 15th I again operated, but increased the current to eighteen milliamperes. In eight minutes the olive passed through the stricture. I then was able to pass a six bougie with ease. He immediately passed his urine without trouble, and in a good stream, the first time for more than a year. No trouble followed the operation, and when he returned three days afterward, I was able to introduce an eight bougie very easily.

On March 23d I again operated, but used a ten olive. It passed through the stricture in three minutes, with a current strength of but twelve milliamperes.

On April 4th, the current was again employed, and upon removing the electrode he was able to pass a good stream. He was very much pleased with the operation, and especially so, since he did not have any chill as he had expected.

He walked around a great deal that afternoon prior to leaving the

city, and upon urinating had a chill. He went home, however, and returned in about ten days very much improved. Fearing another chill he refused a second operation, and though he had been greatly benefited by the single application, he was never entirely relieved of the stricture.

CASE LXXXII. *Stricture of the Urethra of Six Years' Standing*: J. W., aged twenty-seven; came to me complaining of pain in his back, a languor feeling, a constant uneasy feeling in his perineum, painful and frequent micturitions, an incessant desire to pass water, and a sensation as though his bladder had not been entirely emptied immediately following the act. The stream was of a fair size but of a spiral form.

Upon examination I found two strictures; one an inch and a half within the canal, and the other six inches. The anterior stricture admitted a number twelve bougie, while the deep would hardly allow the passage of a number six. As the urethra was not in the least sensitive, and the introduction of the bougies produced very little pain, I concluded to operate on the following day.

I attached an eight olive to the urethral electrode, passed it down to the deep stricture, and employed a current of ten milliamperes. It passed through in ten minutes. No hemorrhage or subsequent inflammation followed the operation.

Ten days thereafter I operated again, and attempted to pass a twelve olive. After allowing a ten milliampere current to flow for fifteen minutes and finding that the olive would not pass, I removed the electrode. Ten days after this, it passed in five minutes.

After waiting twelve days I again operated, and passed a fourteen olive, both through the anterior and the deep stricture, in ten minutes.

I then used sounds every third day for a month, and kept him under observation for another month without doing anything. When I dismissed him I could pass an eighteen sound, all symptoms had disappeared, and he was rapidly improving in general health.

The following case, although it does not strictly come under the category of stricture, is a condition with symptoms so akin to it, and so frequently met with that I think it worthy of mention, both in order to demonstrate a successful method of treatment, and also to show how vigilant the physician must frequently be in discovering obscure causes of morbid conditions, that in a casual examination give no inkling to their existence.

CASE LXXXIII.—J. O., aged thirty-five, applied for treatment August, 1888. He was suffering with melancholia, loss of memory, and insomnia; a part of which trouble he attributed to a love affair and excessive mental taxation. His previous history was good—indulged in no excesses, and never had gonorrhoea.

I treated him by means of tonics and in addition used electricity, but his condition remained unaltered. I then sent him to the country in order to give him rest, but this only served to increase his trouble, and he returned in a week. My treatment in this way extended over a year without the least benefit resulting therefrom. In this time I made all physical examinations by means of which I might obtain a clue to a cause, but I was unsuccessful. His urine was normal, and he had no pains save an uneasy feeling along his spine. I finally thought of the possibility of urethral trouble, and persuaded him to allow the introduction of a bougie.

I discovered an exceedingly sensitive condition of the urethra, and granulations that extended three inches from the meatus back into the prostatic urethra. I made an application of an astringent preparation and told him to return in a week. When he returned he said he was well, and would not submit to a second treatment on account of the unpleasant sensation attending the introduction of the bougie.

Two weeks thereafter he returned, saying that he had a relapse and was feeling as badly as ever. I then introduced a urethral electrode and passed a mild current for five minutes, during which I kept moving the olive over the entire granulated surface. He improved at once, and after three applications in this manner declared himself entirely well. Since then he has had no return of any trouble whatever.

I have treated a number of cases in which granular condition of the urethra produced marked constitutional disturbances, though in none of them was the cause as obscure and entirely devoid of local symptoms as this.

ELECTRO-CAUTERY.

Electro-cautery is the destruction of tissue by means of the galvanic current. It differs from electrolysis, in that it is a process of thermal destruction instead of chemical decomposition, and requires a current of a definite strength before its effects can be produced. While in electrolysis the intensity current is used by preference here,

we have already seen, the quantity current must be employed. In short, the electro-cautery battery is nothing more or less than a convenient means by which may be produced a heat that can easily be regulated in intensity, is of a constant uniformity, and may be so produced as to make its use in delicate parts of the body safe and practical.

BATTERIES.

In electro-cautery there are two forms of batteries that may be employed. They are: The quantity battery proper, and the storage battery.

The *quantity battery* consists of from two to eight or even more cells. These cells are composed of broad plates of zinc and carbon alternately arranged, but instead of being alternately connected as in the intensity battery all the carbons are joined to each other and so also the zincs, the circuit being closed by joining the last carbon with the first zinc.

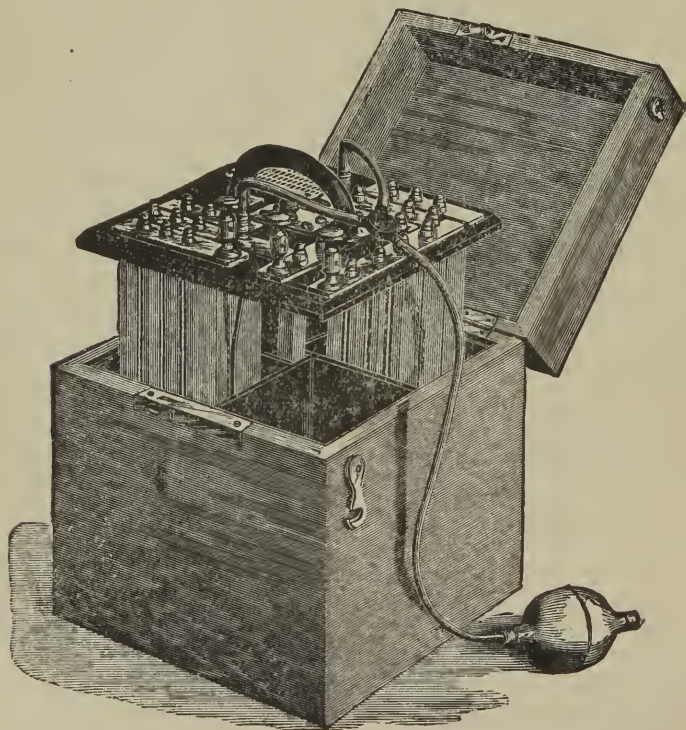


Fig. 30—the Electro-Cautery Battery.

Figure 30 represents an electro-cautery battery, composed of carbon and platinum plates, as made by the McIntosh Battery Company of Chicago, and is one of the best batteries that can be gotten for the purpose.

The substitution of platinum for carbon plates gives a more compact battery without decreasing its power in the least, and hence makes it more desirable as a portable apparatus. The strength of current can be regulated by immersing the elements into the fluid to the necessary depth and retaining them there by means of an upright tube adjusted for that purpose. It also is supplied with a rubber air syringe so as to prevent polarization.

The *storage battery*, (Fig. 30) the principles of which I described in a preceding chapter, is also used as an electro-cautery battery.



Fig. 31—the Storage Battery.

It possesses no particular advantage over the other form save that, when properly charged, the current is somewhat more uniform, owing

to the fact that no polarization takes place among its elements. The strength of current is regulated by a rheostat.

The storage battery, or accumulation as it is frequently called, must be charged and discharged at certain intervals in order to obtain good results by its use. In the Black Giant system where the plates are made of an alloy that is non-corrosive, this is not as necessary as in the other systems, although it should not be allowed to stand unused for too long a time.

ELECTRODES.

The electrodes or cautery knives (Fig. 32) are composed of two insulated copper rods to which a platinum loop is attached. The size and shape of the loop depends upon the purpose for which the electrode is intended. Those used for cutting purposes having a sharp cutting edge (No. 7, 8, 9), those for puncture being pointed (No. 5), while others are so shaped as to be of general use.

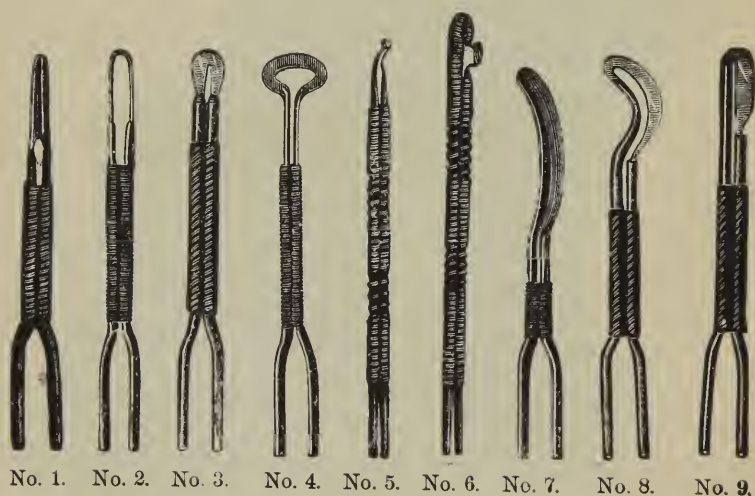


Fig. 32.—Cautery Electrodes.

Among other forms there are: those in which the platinum wire is coiled about a cone of porcelain, constituting the "dome cautery"; and the "cautery scoop," both of which are useful in certain cases.

The cords should be somewhat stouter than those used ordinarily, so as to offer the least possible resistance to the current.

The cautery handle (Fig. 32) should be thoroughly insulated, and be provided with a current interrupter that will enable the operator to apply the electrode directly to the parts to be operated upon before heating it, and also that as soon as the operation has been performed, the current may be broken and the electrode renewed without injuring adjoining parts.



Fig. 33.—Cautery Handle.

The electro-cautery ecraseur (Fig. 33) is a method in which the principles of the snare are combined with electro-cautery. The platinum loop is attached to a ratchet wheel, by the revolution of which the heated loop is decreased in size and thus cuts through tissue of any ordinary thickness.



Fig. 34.—Cautery Ecraseur.

REQUISITE HEAT INTENSITY.

The quantity of current that is forced through the platinum strip regulates the intensity of heat produced within it. With the same current a thin platinum strip will be heated more intensely than would one that is thicker, while if the conducting cords be thick the same strip would be heated more intensely than when the cords are thin and more resisting to the onward flow of the

current. Hence, each cautery electrode requires its individual strength of current in order to evince a certain heat. How this is regulated we saw in the description of the batteries.

By applying the electro-cautery blade to living tissue we notice that upon changing the heat intensity of the blade different effects are produced. If a white heat be generated the cautery blade passes through the tissue with greatest facility and the cut is as clear as that of the sharpest scalpel, and also very similar to it in effects, since a copious hemorrhage is produced by both. If, however, a red heat be generated, it will be found that not only will the cautery blade not cut the tissue as readily, but also that there will be very little if any hemorrhage, and that the cut, instead of being clearly defined as in the other instance, presents a rough appearance and is covered with a crispy scab.

From this we may deduce two important properties proper to electro-cautery, both of which have their individual indications :

The cautery blade or loop is brought to a white heat, when it is desired to make a sharp, clear cut, regardless of the hemorrhage resulting therefrom ; as, in the removal of pedunculated tumors.

The cautery blade is brought to a red heat when it is desired to operate without producing hemorrhage or leaving a bleeding surface ; as, in the reduction of hypertrophied tonsils, or the destruction of indolent ulcers.

Frequently it will be found of advantage, particularly in operating upon large surfaces, or even in minor operations, to first perform the operation with the cautery blade at a white heat and subsequently reduce it to a red heat and sear the cut surface.

Even in the most vascular tissues of the body, the searing heat is one of the most efficient of hemastatics.

Before attempting an operation by this method it is essential that the electrode which is to be used be adjusted, and the current passed, in order to note the amount of electricity required to heat the blade to the desired intensity. Especially is this important in operations within the nose or pharynx and similar obscure operations where, after the electrode is introduced, the exact intensity cannot be demarcated.

ADVANTAGES AND USES.

The advantages of this method of operating over the knife in cases

where it is practicable are both important and numerous. The pain during the operation is always less, and frequently may be entirely wanting. It invariably ceases immediately after the operation and leaves the wound in a less irritable state. In consequence of diminished pain, shock is less than by any other method. By carefully heating the electrode hemorrhage may be entirely avoided, and an otherwise very bloody operation be performed without the loss of any blood whatever. And most of all, operations by this method may be performed in places where it would be impossible to operate by any other means. By placing the cautery blade into proper position over the part to be operated upon, no matter how difficult of access the situation, so long as the electrode can be introduced and the operator be not groping in the dark, the operation may be performed equally as well as one in a less hidden locality.

This method has been employed in a number of major operations, while it is used constantly and by some exclusively in the performance of many of the minor operations. Successful amputations of the neck of the uterus have been reported by a number of gynecologists. Bryant reports several amputations of the tongue and regards it as the best method. Cancers of the breast have been removed successfully by this means. Tracheotomy has also been performed, and the removal of nasal and pharyngeal polypi is a quite common operation.

In the removal of nasal and pharyngeal polypi the electro-cautery ecraseur is used. The loop should not be brought above a red heat and this properly gauged before introducing it. The loop is thrown over the polypus and snugly closed around its pedicle. The circuit is then closed and at the same time the loop tightened until the pedicle is severed. The polypus is then removed by means of a tenaculum or pair of forceps. If the loop has not been raised to more than a dull red heat there will be no subsequent hemorrhage.

In the removal of tumors without the body the cautery knife is used. It may be either raised to a white heat, the tumor hastily cut away, and the wound subsequently seared so as to stop the flow of blood, or it may be slowly dissected away by a blade of a red heat without any hemorrhage.

In the reduction of hypertrophied tonsils where the glands had become extremely large and boggy, I have made use of the galvano-

cautery in a large number of cases. After a tonsil has reached a certain stage of hypertrophy, palliative treatment becomes of no avail and relief lies either in the use of the tonsilotome or the galvano-cautery. The cutting of a tonsil, particularly in an adult, I regard as a dangerous procedure and besides, for the most part, entirely unnecessary. On the other hand, it may be sufficiently reduced or even entirely removed without any danger by the use of the electro-cautery. In performing the operation I usually employ a pointed electrode heated to a red heat, and make several punctures in different parts of the gland at one sitting. Three or four sittings generally suffice to reduce a largely hypertrophied tonsil to its normal size. There should be a sufficient interval, usually three or four days, between each sitting to allow the subsidence of all inflammation that may be produced by that operation.

The operation may be rendered entirely painless by the application of a ten per cent. solution of cocaine muriate to the tonsil.

CASE LXXXIV.—*Reduction of Hypertrophied Tonsils*; Miss R., aged twenty; suffered for several years with hypertrophied tonsils that affected her voice to a marked degree. Whenever she took a slight cold, they would become inflamed to such an extent that she was unable to speak above a whisper.

Before she came to me for treatment, she had been using various gargles and local applications of astringents, but they gave her no relief. When I suggested reduction by means of the galvano-cautery she refused, and begged me to first try to reduce them by the use of medicines. I did so, and treated her with local applications of iodine and other astringents for a month, but the hypertrophied condition still persisted. She then gave her consent to a single operation.

I applied a ten per cent. solution of cocaine, and made two punctures into each tonsil. She experienced no pain whatever, and three days thereafter returned so delighted with the result that she wanted me to operate again. I did so, and this time made three punctures into each gland. Four days thereafter she returned saying that her throat had not felt as easy in two years. Upon examination I found that the tonsils had been reduced to their normal size and presented a more healthy appearance. I made two more punctures into each gland and dismissed her from treatment. She has had several colds since, but her tonsils have given her no more trouble.

In the destruction of ulcers I have found the galvano cautery of great benefit. The electrode is brought to a red heat and, after the use of a solution of cocaine, the entire surface of the ulcer is thoroughly seared. This usually produces a healthy scab and the wound subsequently heals without further trouble.

In the destruction of chancroids it is far superior to applications of nitric acid and not near as painful. While nitric acid produces pain that will at times last for several hours, the pain caused by the application of the galvano-cautery electrode is less severe during the operation, and ceases almost immediately thereafter. By its use the depth of tissue destruction can also be more accurately judged, and there is no danger of producing unnecessarily deep tissue destruction. Besides this, if the operation has been effectually performed and all the virus destroyed, the incrustation produced upon the site of the ulcer is composed of non-irritating material and heals with less trouble.

My usual method of procedure is to apply a ten per cent. solution of cocaine and allow it to absorb for about five minutes. I then produce a red heat in the cautery blade and thoroughly sear the ulcer, after which calomel is dusted upon it. Frequently but one application will suffice to destroy all virus.

In the treatment of hemorrhoids the cautery loop forms the most serviceable electrode. The operation is performed by anaesthetizing the parts with cocaine, then forcibly dilating the sphincter and drawing down the hemorrhoid by means of a polypus forceps. The loop is then thrown over the hemorrhoid, snugly encircled about it, and a red heat produced. Or, the "dome cautery" may also be used. This is raised to a red heat and applied to the tumor. The parts are then dressed as in any of the other operations.

The advantages presented by this method are: The avoidance of all dangers of pyaemia, septicaemia, or phlebitis. It is applicable to the removal of both internal and external hemorrhoids. No unnecessary tissue is destroyed and hence cicatricial contractions avoided. And what is more desirable to the patient, it is almost entirely painless.

CASE LXXXV.—*Hemorrhoids*: E. V., aged forty, came to me for treatment for large protruding hemorrhoids. At times they became strangulated and caused very much pain. I applied a strong solution of cocaine, both to the tumor and surrounding membrane, and after

drawing it well down applied the cautery loop. In a few minutes it came away and the wound showed no tendency toward bleeding. He suffered some pain during the operation, although it was not at all severe. In two weeks the wound had entirely healed.



CONCLUSION.

CARE OF BATTERIES : It is as essential to keep the batteries in good working order as it is to know how to apply the different currents. No matter of how fine construction and how carefully used, the best of batteries are liable to become out of order occasionally. As a rule it is no difficult matter to maintain a strong and uniform current with but comparatively little trouble, if the operator is thoroughly acquainted with the principles and construction of the battery he is using.

In the office battery, each cell should be separately examined at least once a month, in order to see if the fluid requires to be renewed and also to ascertain the condition of the zincs. The strength of the fluid and its necessity of renewal, if the other elements are intact, may be ascertained by means of the galvanometer. Before adjusting the zinc elements they should first be thoroughly amalgamated so as to diminish polavization and unnecessarily rapid decomposition. This is done by dipping the zinc into pure hydro-chloric acid and subsequently pouring metallic mercury over it. After the elements have been properly fastened and the fluid poured into the cells, care must then be observed that proper connections are made among the different cells and also with the cell selector. In the office battery, where the current is one of intensity, the zincs and carbons are alternately connected. The insulated wire from the carbon of the first cell runs to the switch of the current selector, while one wire runs from the first zinc to the point number one in the selector circle and another to the carbon of the second cell. Frequently the cells become polarized—bubbles of hydrogen accumulating upon the carbons and oxygen upon the zinc that set up a counter-current and weaken or even neutralize the proper current and thus destroy the working properties of the battery. In this case all that is necessary is to lift out the elements and allow the gas to escape.

In the portable batteries, the elements should not be retained in the fluid any longer than absolutely necessary, and on being taken out should always be rinsed in cold water, so as to remove all the acid. In this way the zinc elements may be made to last again as long as when the battery is carelessly set aside after being used, and the chemical action not arrested. Besides, this will insure a stronger and more uniform current and one that will be less likely to become weaker if used

for any length of time. The same precautions are also applicable to the cautory battery.

Some manufacturers advise the amalgamation of the zincs by the mixing of bi sulphate of mercury to the battery fluid, which, by decomposing, causes a continuous deposit of metallic mercury upon the zinc. I do not regard this as being a very satisfactory method ; because, frequently the oxidizable element is irregularly amalgamated, and this produces an interference in the flow of the current. It is much better to apply the mercury directly to the zinc after it has been immersed into an acid so as to insure a uniform amalgamation.

BATTERY FLUIDS

Cells of different construction require fluids of different strength and constitence in order to insure perfect action, although the underlying principle, that of chemical decomposition, is the same in all. A fluid of such a strength should be used that will produce sufficient decomposition to generate a good current and still not cause an unnecessary destruction of elements. In my office battery where the Laclanche or Diamond Carbon cells are preferable, I use a saturated solution of ammonia muriate.

In the portable Faradic and Galvanic the following fluid I regard as being one of the best :

Potass Bichromate, saturated solution, parts 9.

Sulphuric acid, part 1.

The acid should be poured into the solution of potassium bichromate and allowed to cool before using the battery.

In the cautory battery a stronger fluid is required and the parts of sulphuric acid should be one, in six of the saturated bichromate solution.

INDEX

	PAGE
Amenorrhoea	70
Ampere	23
Aneurism	85
Animal Electricity	26
Anode	27
Apostoli Clay Electrode	27
Battery, Care of	127
Battery, Cautery	118
Battery, Faradic	24
Battery, Fluid	128
Battery, Galvanic	12
Battery, Office	24
Battery, Portable	25
Battery, Storage	119
Bladder, Diseases of	77
Brain, Diseases of	38
Cathode	27
Catuary Blades	120
Cautery Handle	121
Cautery Ecraseur	121
Cell, Bunsom,	13
Cell, Galvanic	12
Cell, Gravity	14
Cell, Laclache	13
Choea	60
Constipation	64
Current, Galvanic	14
Current, Effects, Chemical	28
Current, Effects, Cutaneous	28
Current, Effects, General	27
Current, Intensity	14
Current, Inantity	14
Current, Faradic	16
Current, Effects	28
Current, Primary	16
Current, Secondary	17
Current, Static Effect	18
Diarrhoea	66
Dysmenorrhoea	72
Electric Head Bath	22
Electric Cabinet Vapor Bath	36
Electric Tub Bath	37
Electro-Cautery	117
Electro-Diagnosis	29
Electro-Massage, Static	23
Electro-Physics	11
Electro-Physiology	27
Electro-Surgery	79

INDEX—Continued.

PAGE

Electro-Therapy	31
Electrodes	32
Electrolysis	79
Epilepsy	58
Faradisation, General	31
Faradisation, Localized	31
Galvanization, Central	31
Galvanization, General	31
Galvanization, Localized	31
Hair, Removal of	81
Hemorrhoids	125
Kidneys, Diseases of	77
Liver, Diseases of	68
Milliampere	23
Milliampere-Meter	23
Neuralgia	48
Ohm	23
Opium Poisoning	75
Ovarian Neuralgia	98
Paralysis	40
Prolapsus Uteri	103
Rheumatism	55
Sciatica	50
Skin, Diseases of	54
Sprained Ankle	75
Stricture	105
Subinvolution	98
Static, Breeze	20, 21
Static, Induced Current	22
Static, Insulation	20
Static, Spark	19—20
Tonsilitis	73
Tonsils, Hypertrophy of	124
Tumors, Removal of	84—88—99
Varicose Veins	87
Volt	23
Women, Diseases of, Functional	70
Women, Diseases of Organic	90
Writer's Cramp	47

NATIONAL LIBRARY OF MEDICINE



NLM 00103423 1